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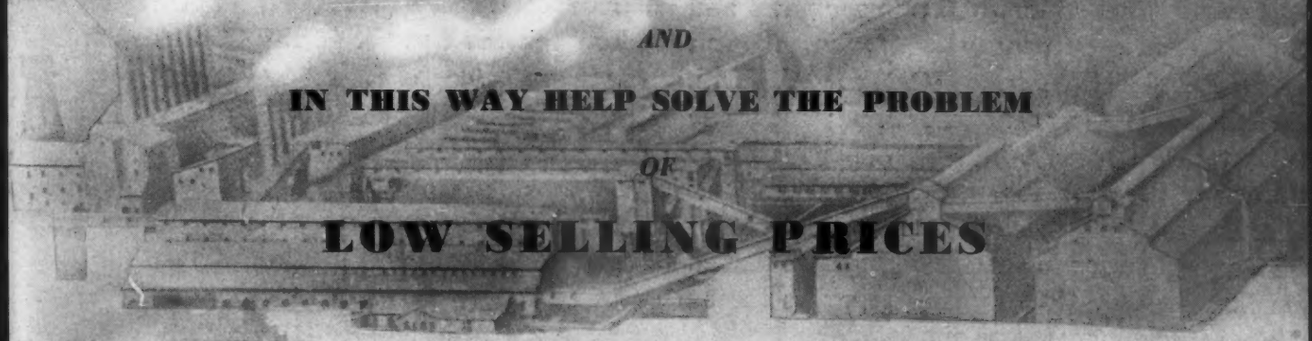

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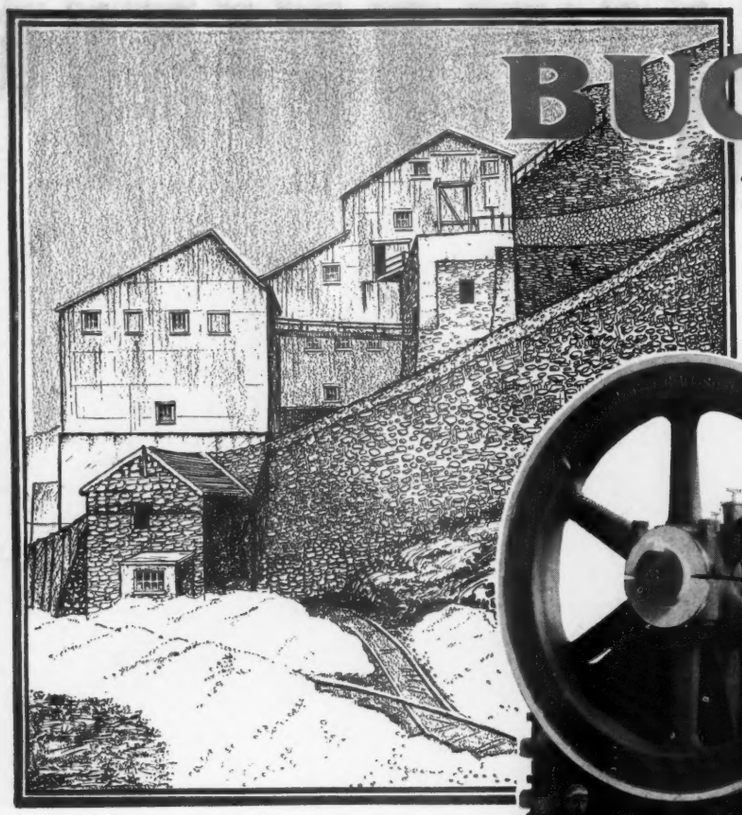

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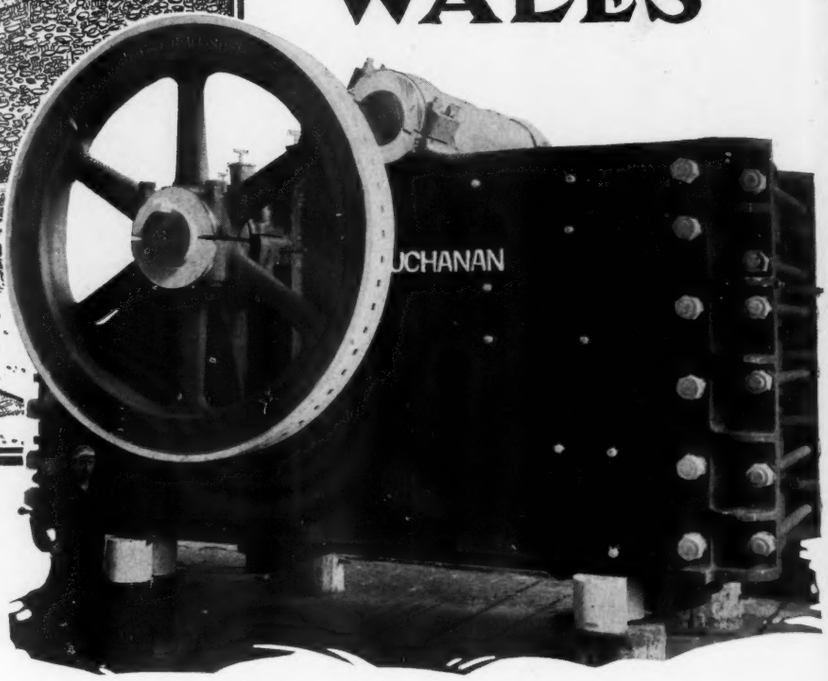

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NOTE—In order to give the editors more time in the preparation of two extra big issues and to avoid 27 issues of Rock Products in the calendar year 1932, the publication dates in January are January 9 and January 30. After January 30 the issues will appear every two weeks as before. The January 30 issue will be largely devoted to reports of the Pittsburgh conventions of the aggregate and ready-mix concrete industries.—The Publishers.

Trends are Important

A GREAT DEAL of pertinent information for every rock products producer and manufacturer is crowded between the covers of this issue—unattractive as the material may look to one who merely thumbs over the pages. It is different from our previous Annual Review Issues in several respects, chiefly because with our longer acquaintance and constantly closer contacts with our industry we are capable of generalizing more intelligently. In this issue we have concentrated on *trends* rather than statistics. Statistics are useful but not interesting; trends are vital, and to the ambitious, of absorbing interest.

The deflationists have won. The rock products industry has been deflated in volume, prices, but we hope not in morale. The construction industry generally has been deflated except for union labor building trades wages, and taxes. Evidently a revival of building must await revision or deflation of these. Therefore this deflation should be hastened in every way by all who live by construction. When deflation has reached its limit, inflation will begin again. Plans are already proposed by the President and laid before Congress for such inflation. For inflation is prosperity and deflation is hard times. Just why we have to be alternately inflated and deflated, instead of maintaining a constant girth puzzles us yet, but so be it. Anyhow, all agree we are pretty nearly deflated 100%, so we must be near the point of being inflated again.

The inflation or coming of a building boom will probably be long drawn out. To survive in the interim will call for all the ingenuity management can muster. This issue of ROCK PRODUCTS gives many examples of such ingenuity. A manufacturer of a quick-hardening high alumina cement, finding it difficult to compete with high early strength portland cement, has found a market for it as a refractory cement. Lime and cement manufacturers are contending for the mortar market with various combinations of cement, lime, slag, boiler ashes, or other puzzolanic material—recognizing a demand for a mortar material of certain properties, where formerly they considered their own materials, unadulterated, entirely sufficient. A lime manufacturer has developed a waterproof lime for mortar; another makes a special lime with a certain constant percentage of magnesia. A gypsum manufacturer has developed a tremendous new potential market for gypsum as a paper filler; another makes wood-grained gypsum wall board. Sand and gravel producers are developing new markets—"lawn sand" for example. Crushed stone producers are turning to special products—stone sand for example. All aggregate producers are striving to eliminate unsound elements in their product, are turning to more finished products, such as ready-mix concrete and asphalt road mixtures. A silica producer trade-marks and guarantees his products for various foundry purposes. A feldspar producer has developed a new product and a new use for it in glass manufacture. And so we might go on.

The point is that in a buyers' market, the buyers' wishes, desires and specifications are important. The producer who does not recognize this trend, and patiently awaits a return of a sellers' market, simply won't be there when and if a sellers' market returns.

There are other distinct trends in the aggregate industry. They appear in conflict, but are not if we face issues squarely. There are city plants with established and lasting markets that are fast becoming real mills or factories, making a variety of raw and finished products. There are country plants of transient or wasting markets, which must not be confused with the first class, either technically or commercially.

There is a trend toward prices that represent at least all the *costs* of production. The reason is simple enough. Very few business enterprises can exist for more than a year on their surplus. When they divert or eliminate depletion, depreciation and maintenance charges in order to exist temporarily on their out-of-pocket cost they are actually operating on their necessary surplus. Apparently every business man has to experience this at least once in a lifetime in order to have it make an impression. Then he starts to get back *all* his costs. In 1932 rock products producers who survive will do this.—The Editors.

Cement Industry Not So Badly Off As Nearly All Other Industries

Shipments Were But 28% Less Than the Peak Year of 1928

A COUPLE of short years ago of course the caption of this article would not have looked very encouraging. But judged by the experience of any other basic commodity industry, or of any other building material industry in particular, portland cement manufacturers ought to have cause for considerable satisfaction. For no other basic commodity with the exception of petroleum has held up in consumption anything like portland cement. And in these days 50% of capacity is a pretty good showing (think of the steel industry for example operating at about 25% of capacity). Also in view of present and prospective demands for improved quality at low prices, it is probable that the "capacity" of the industry is liberally estimated. Probably a considerable percentage of that capacity may be already obsolete under present and prospective competitive conditions.

In view of these facts the price situation in the portland cement industry during the past year was hardly justified or justifiable. It can only be accounted for by panicky moves caused by the collapse of commodity prices in general or by fear of the *possible* effects of 50% overcapacity, even though a fair percentage of that overcapacity was perhaps more imaginary than real. Certainly other industries can operate and have operated at 50% capacity at a profit. There is no reason to believe the cement industry is an exceptional case. Its plants, usually having two or more kilns and corresponding multiple grinding units, etc., should be far more capable of effective and efficient operation at 50% capacity than plants in many other kinds of industry which are much less elastic in design.

It seems obvious, at least to an outside observer, that all the cement industry needs is a realization that it is entirely possible to make a profit on 50% capacity operation. Then if producers will make up their minds to be satisfied for the time being with 50% capacity operation it is certain they will find a way to operate profitably. However, when we say "producers" we mean *all* producers, because the great majority of producers are even now attempting to operate on such a basis. The redistribution of a very small percentage of the total shipments for 1931, to avoid cross-hauls and unjustified invasion of one another's legitimate territory, would have obviated nearly all the cut-throat competition so much in evidence.

The best evidence that present cement prices are accepted as less than cost is that the present market for cement company securities has reduced the value of capital invested per barrel of capacity, or per barrel of shipments of existing companies, very much below what it would be possible to build a new plant for. In other words the financial powers recognize that present prices do not allow any margin for return on capital invested, even on a cost of reproduction basis.

What Does It Cost to Make Cement?

There has been a great deal of loose talk about the actual cost of making cement, and about the economies effected in new plants over old ones, or the possible economies that could be effected in plants projected. In these discussions too often several factors in actual cost of the cement at the mill, not to mention the cost delivered to the customer, are overlooked. Some of the lowest cost producers are not the newest plants, but older ones which have the advantage of favorable location, low investment cost, experienced management, long standing market contacts, prestige, etc. The following analysis of cost is based on the very best authority and should be helpful in checking the claims, both of producers who are attempting to fool themselves, and of would-be producers who would fool investors:

In the first place, prime manufacturing cost in bins (which is what operating men talk about) is in practically all cases less than one-half of the total cost of cement f.o.b. plant. In fact in most cases it runs about 40% of this total cost. There are, of course, a few plants well managed and favored by natural conditions which are very low in this part of the cost, and there are a good many plants which because of their raw material situation or otherwise have very high manufacturng costs, but the majority of plants are probably within striking distance of 60c per bbl. and for this class variations above and below this figure are only pin money compared with variations in market price.

Packing costs and expenses in connection with packing, plus selling expense, plus general overhead, plus administrative expense, will in most cases range between 20 and 25% of total cost.

The other big item of cost is capital charges, that is, depreciation and interest on capital invested. Depreciation actually charged in most cases ranges between 15c and 25c per bbl. and 15c would be a minimum reserve to keep any plant in efficient up-to-date condition over a long period of years. The return on capital invested should be figured on reproduction cost. If we assume that an efficient plant can today be built and furnished with working capital at an outlay of $2.00 per bbl. (which probably is too low), 10% on this would be 20c per bbl., assuming, however, that the plant operates at full capacity. As we know that the industry has an overcapacity of 100% and that no new plant or any other plant would be permitted by its competition to operate at 100%, we have to discount this very materially. If the plant operates at 50% capacity the capital charges would be 40c per bbl. of shipments, if at 70% about 30c per bbl., etc.

Put these figures together and we arrive at an average total cost of cement ranging from $1.20 to $1.50, and this must be somewhere near the average cost for the industry, as at present constituted. Moreover, the manufacturing cost, as affected by long kilns, modern design and all the other things that promoters talk so glibly about, is a very small factor in the total cost and would mean little or nothing toward the financial success of the enterprise.

Manufacturing costs can be conveniently subdivided into the following items: Fuel, power, labor, repair and supply material, explosives, gypsum, purchased rock and plant overhead, including interest, insurance, taxes, etc.

Fuel consumption in cement kilns should run about as follows: For the Lepol process about 60 lb.; for the very long kilns about 85 lb.; for dry process plants or wet plants with filters about 100 lb.; for wet plants without filters about 130 lb. With coal at $3.60 a ton delivered this is a variation of between 11 c. and 23 c. per bbl., but the Lepol process is not so far used in this country and can be used only for dry plants without waste-heat boilers, and it is becoming generally admitted that wet plants are uneconomical unless equipped with filters or with very long (400 ft.) kilns.

Power consumption is relatively constant, as cement now has to be ground. The great majority of plants will run 18 kw.h. per bbl. plus or minus 10%. Purchased power

usually varies between 6 mills and 9 mills, giving a cost range of from 11 c. to 16 c. On the other hand, waste-heat power should cost only 3 c. or 4 c. per bbl., excluding capital charges.

On labor there are a few plants operating with as low as 0.25 man-hours per barrel, and there are also a good many plants with 0.60 man-hours per barrel, or above, but the great majority are operating between 0.30 and 0.50, which with labor at an average cost of 50 c. per man-hour amounts to 15 c. to 25 c. per bbl. It is well known that some of the lowest labor plants in the industry are very old plants which have been modernized from time to time and are usually well managed. Theoretically, however, the new plants with their simplified layouts should have some advantage on this item.

Repair material will usually run between 5 c. and 15 c. per bbl., and in this case the modern plants do have a considerable advantage due to their simplified layout. However, there are plenty of old plants that will run around 8 c. or 9c.

The other items of cost are relatively constant or do not bear any relation to the date at which the plant was built. In fact the modern plant is apt to be at a disadvantage on the raw material situation because naturally the older plants had the first choice as to locations.

If the cost differentials are set down as between a modern 400-ft. kiln plant and an old plant, dry process or wet process but modernized with filters and in each case with waste-heat boilers, the advantage for the new plant might work out about as follows: On fuel about 3 c. advantage, labor, say, 5 c. advantage, power 10 c. disadvantage, repairs 5 c. advantage, total prime cost about 3 c. advantage. Of course, in addition there is the theoretical advantage due to lower capital charges through using purchased power in place of waste-heat power, but practically a new plant has no such advantage because the existing plants have made their investment and the market has written it down to a low figure per barrel of capacity.

So, if operators are honest with themselves and promoters honest with their prospects, it can be readily seen that the cost of portland cement manufacture has been pretty well standardized and no operator who does not wilfully try to operate at 100% capacity at the expense of his competitors can afford to cut prices as they have been cut on the theory that his costs are appreciably lower than the other fellow's.

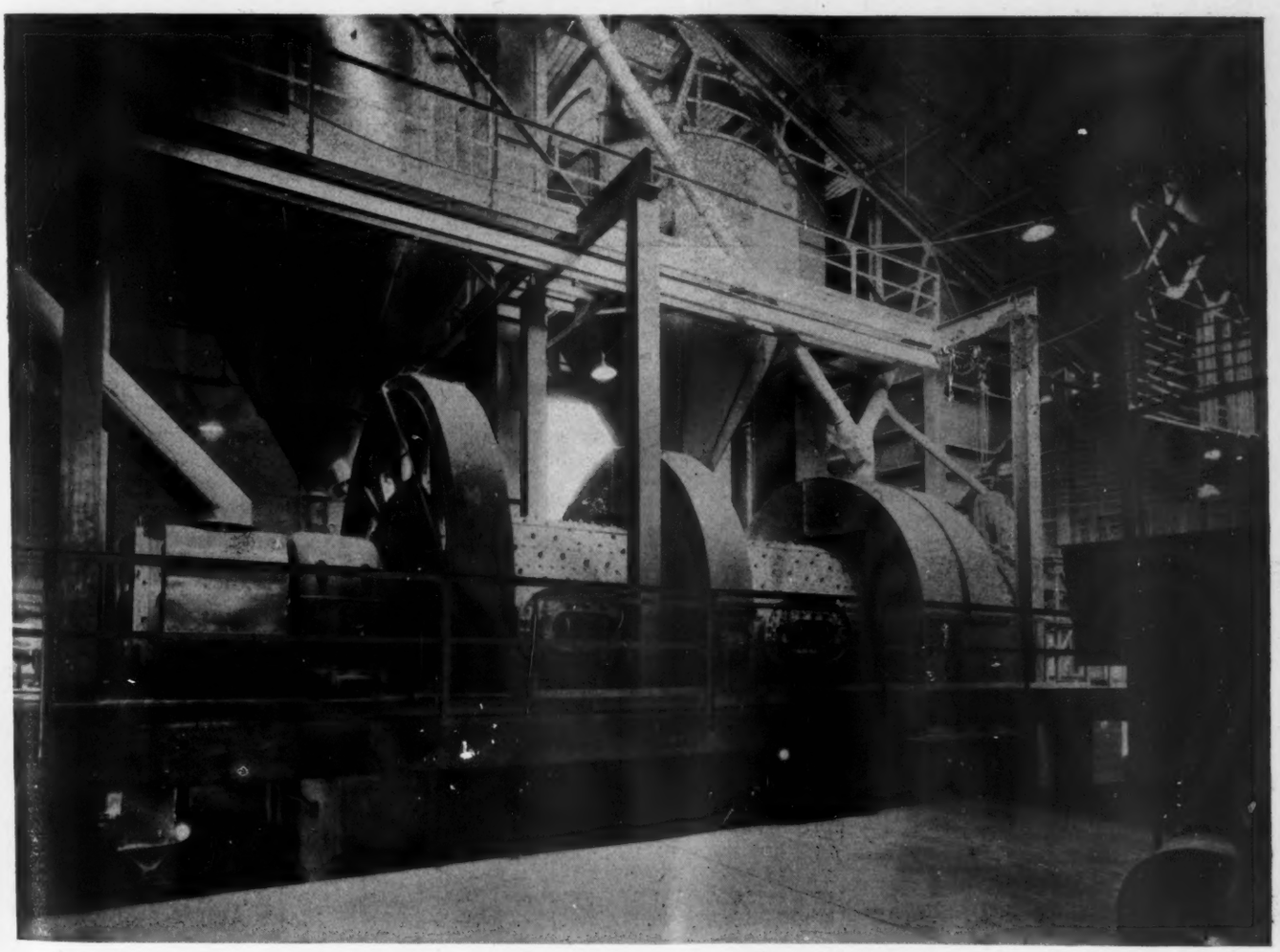
Production—Shipments

Based on U. S. Bureau of Mines figures for 11 months and a conservative estimate for December, the production of portland cement for 1931 was 124,800,000 bbl. Compared with a production of approximately 161,200,000 bbl. in 1930, this is a loss of 22½%, and compared with the peak production of 1928, a loss of 29%.

Shipments in 1931 were approximately 127,000,000 bbl. compared with 159,000,000 bbl. the year before—a loss of 20%; and compared with the peak year, 1928, shipments were 28% less.

These figures indicate a total productive capacity of a little more than twice the consumption of the past year, the percentage of plant capacity utilized having fallen from 66% in 1929 to 60% in 1930 and to 48% in 1931.

In common with all other basic commodities prices of portland cement have shown a marked decline, perhaps 20% from the previous year. With the increase in productive capacity over the past few years and the decrease in demand during the year, prices were cut in various sections in the effort to gain more business at the expense of the other fellow and operate at a greater percentage of capacity.



Three-compartment mill with air separators installed during the year

The decline in average factory value has been from $1.57 per bbl. in 1928 to $1.48 in 1929, $1.44 in 1930 and now to an estimated $1.17 per bbl. in 1931.

While much cement has been sold or contracted for at less than $1.17 per bbl. (mill price) probably $1.17 just about represents the actual cost at an average up-to-date mill. Where the price has been less it is obvious that the producers have been drawing on their depreciation reserve or surplus to pay a part of the cost. While this has permitted many companies to maintain strong cash positions, it is of course a very hazardous proceeding and is likely to seriously affect the ability of these companies to maintain their positions in the competition for low costs and high quality which is likely to be very keen for several years to come. Probably such producers expect to make good their reserve depletions by borrowing later on.

Labor

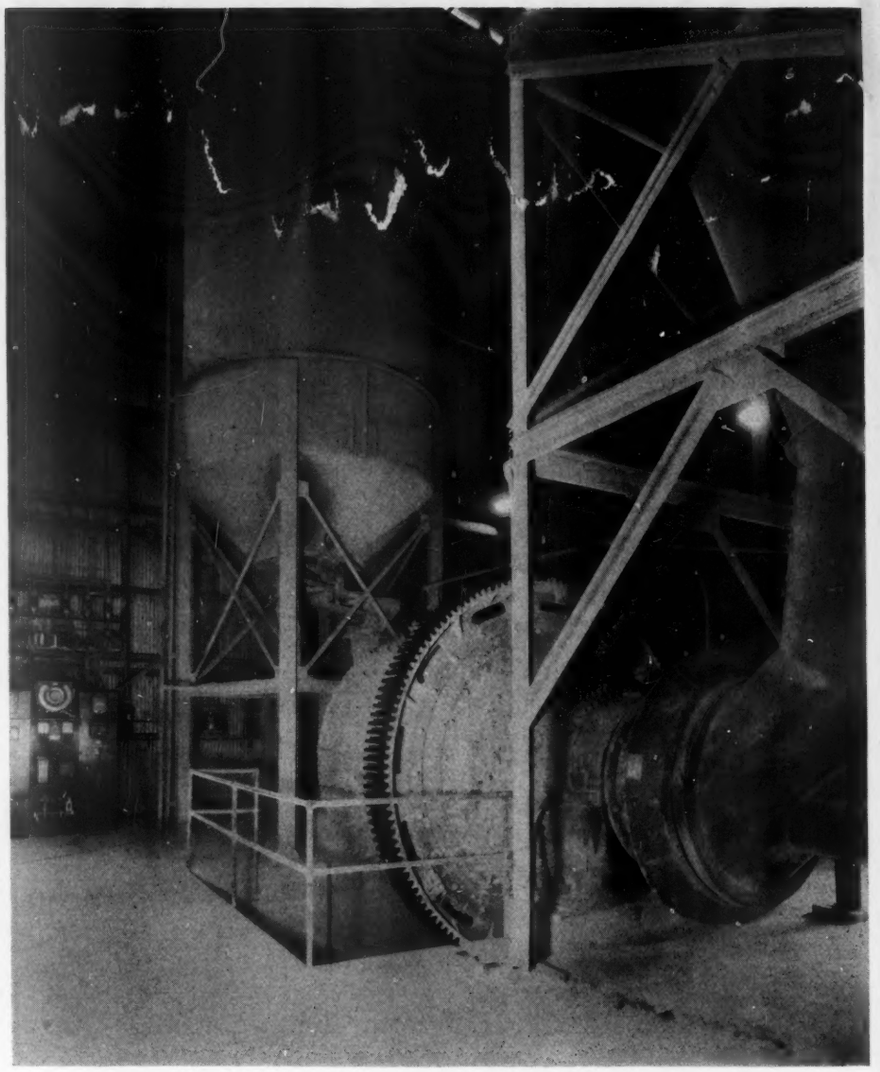
According to information obtained from questionnaires and other sources, wages have been reduced about 10% from the peak of 1928. About half of the operators reporting indicated a reduction in wages of 10%, approximately one-fourth reported no reduction and the balance reported reductions of from 15 to 20%. These figures refer to wages only. It is our belief that salaries have been much more radically cut than wages.

The number of employes has been reduced generally, compared with the peak year of 1928, ranging up to 50% in the case of those reporting. The average reduction seems to have been about 25%. During the year at least two operators put into effect the 6-hr. shift in order to help relieve the present unemployment situation and distribute as far as possible the available employment. No immediate increase of wages with improved business conditions is looked for by most of the manufacturers.

Maintenance and Upkeep

The plants have been kept up and maintained in good condition, according to those reporting, with an average expenditure for maintenance of 80% of normal for 1931 and an anticipated expenditure of 85% for 1932.

According to the reports received, the operators expect the first half of 1932 to be about the same as last year or slightly better with further improvement during the latter part of the year.



An air-swept mill installation

Significant Developments

Many changes and improvements were made during the year for the purpose of improving generally the efficiency of operation, reducing costs and bettering the quality of the product. This is particularly noticeable in the number of additional closed-circuit

PORTLAND CEMENT PRODUCTION BY DISTRICTS

Districts	Production in thousands of barrels				% change from peak year	% change from last year	Shipments in thousands of barrels				% change from peak year	% change from last year
	1928	1929	1930	1931*			1928	1929	1930	1931*		
Eastern Penn., N. J. and Maryland	39,277	37,727	35,141	28,326	—28	—19	39,436	37,647	35,357	28,386	—28	—20
New York and Maine	11,481	11,419	11,342	10,431	— 9	— 8	11,353	11,520	11,122	10,819	— 6	— 3
Ohio, Western Penn. and West Virginia	18,336	17,936	17,620	11,236	—39	—36	18,036	17,737	17,068	11,123	—38	—35
Michigan	13,900	13,749	11,511	6,038	—56	—47	14,041	13,326	10,818	7,212	—49	—33
Wisconsin, Illinois, Indiana, Kentucky	22,684	21,378	20,233	15,178	—33	—25	22,593	21,171	19,572	15,928	—29	—19
Va., Tenn., Ala., Ga., Fla. and La.	15,936	13,793	12,881	12,226	—23	— 5	15,732	14,047	12,729	12,459	—21	— 2
Eastern Missouri, Iowa, Minn. and S. Dak.	16,687	15,697	16,694	13,178	—21	—21	16,503	15,984	16,886	12,387	—27	—27
Western Mo., Neb., Kan., Okla. and Ark.	10,931	12,393	12,510	8,924	—29	—29	11,220	12,267	11,880	9,635	—21	—19
Texas	6,345	7,374	6,781	6,291	—15	— 7	6,277	7,084	6,792	6,354	—10	— 6
Colo., Mont., Utah, Wyo. and Idaho	2,744	2,695	2,269	2,155	—21	— 5	2,575	2,766	2,375	2,025	—27	—15
California	13,704	13,092	10,124	7,810	—43	—23	13,745	12,965	10,439	7,832	—43	—25
Oregon and Washington	3,943	3,393	4,091	3,014	—26	—26	3,944	3,354	4,021	2,901	—28	—28
	175,968	170,646	161,197	124,807	—	—23	175,455	169,868	159,059	127,061	—28	—20

grinding installations which have been made during the year.

At least 10 plants installed such systems for the preparation of the raw material and additional installations of this kind were made for clinker grinding. The Allis-Chalmers Manufacturing Co. furnished two large three-compartment mills in connection with air separators for raw grinding and the Dorr Co. furnished the second installation of its system for wet closed-circuit grinding. This consisted of two classifiers in closed-circuit with two ball mills, followed by two bowl classifiers in closed-circuit with two secondary mills, the finished slurry being thickened in a large Dorr traction thickener.

Additional installations of Oliver-United slurry filters were made at three plants. Dust-collecting systems of various kinds for the collection of stack dust were installed at five plants, including two Cottrell electrical precipitation systems and a Dracco bag type collecting system.

Two complete Fuller-Kinyon raw blending systems with large storage silos were installed at two plants and additional finished cement storage silos were added at several.

The trend toward longer and more efficient kilns is again shown in the installation at several plants of long kilns, these being up to 400 ft. in length for wet process burning and almost 300 ft. long on the dry process.

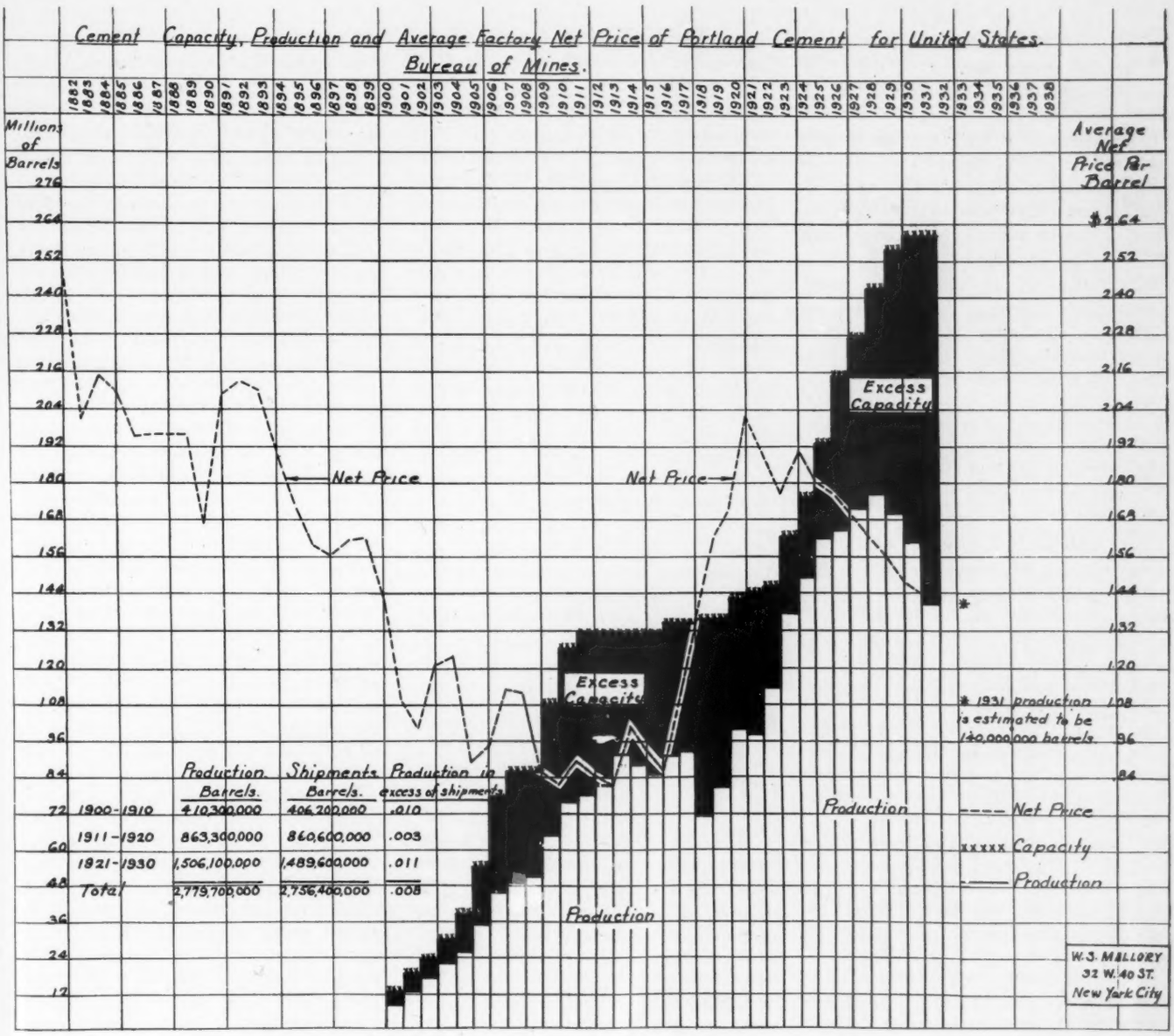
The largest cement manufacturer, the Universal Atlas Cement Co., a subsidiary of the United States Steel Corp., has been engaged in an extensive rebuilding program in which the Buffington, Ind., No. 6 plant has been further modernized during the year. Here a new raw blending system and a new waste-heat boiler installation were put into operation, along with a Cottrell precipitation system for the collection of stack dust. The kilns were also lengthened for better fuel economy.

In Canada the Canada Cement Co., Ltd., has been carrying on its reconstruction program of converting its dry-process plants to modern wet-process plants. At the Montreal No. 1 plant this change was completed during the early part of the year. It included an installation of five Smidth Uni-kom grinding mills 46 ft. long and 7¼ and 11 ft. in diameter with Symetro drives (the first Uni-kom mill installation on this continent).

The Port Colborne No. 8 plant of the Canada Cement Co. is now being changed over to the wet-process. It will have a 420-ft. Smidth kiln with Unax cooler and chains on the feed end and two Unidan mills on the raw end.

In Mexico, the year 1931 brought many changes in the portland cement industry through the placing into operation of several new plants and the amalgamation of several of the existing plants.

During the early part of the year Cementos Monterrey, situated at Monterrey, Nueva Leon, combined with Cementos Hi-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Excess Capacity
Production
* 1931 production is estimated to be 140,000,000 barrels
---- Net Price
xxxxx Capacity
——— Production
W. J. MALLORY
32 W. 40 ST.
New York City

	Production Barrels.	Shipments Barrels.	Production in excess of shipments
1900-1910	410,300,000	406,200,000	.010
1911-1920	863,300,000	860,600,000	.003
1921-1930	1,506,100,000	1,489,600,000	.011
Total	2,779,700,000	2,756,400,000	.008

Capacity, production and price of portland cement in the United States

dalgo situated at Hidalgo, Nueva Leon, to form the newly organized company Cementos Mexicanos with headquarters at Monterrey.

In April the new unit and allied machinery of Compañia de Cemento Portland "Landa," S. A., at Puebla, state of Puebla, was placed in operation.

About the middle of the year Compañia de Manufactura de Cemento Portland "Cruz Azul," at Jasso, Hidalgo, was purchased by La Tolteca Compañia de Cemento Portland, S. A., at Tolteca, Hidalgo, while during the latter part of the year the Tolteca company started its new plant near Mexico City.

During the latter part of the year the Cementos Portland Nacional, S. A., Hermosillo, Sonora, started operating its new plant.

The plant of Compañia de Cemento Portland "Apasco," S. A., at Apasco, Hidalgo, upon which construction was started in 1930 was still under construction.

The 500 bbl. per day capacity wet-process plant of Compañia de Cemento Portland "Azteca," S. A., at Puebla, was placed under construction during the year, it being the only wet-process plant attempted in Mexico, its operation will be watched with interest.

In South America considerable activity in the way of new plants has been noticeable. The Cia. Nacional de Cimento Portland, Rio de Janeiro, Brazil, a subsidiary of the International Cement Corp., has been constructing a new plant, and there are rumors, according to consular reports and other sources of information, that additional plants are to be built.

In this country several new plants have been proposed, three or four in California, a plant for Mississippi, and agitation for state-owned plants continues in Oklahoma, Mississippi and Texas. One state-owned plant, that in Michigan, because of its operating deficit, was ordered sold.

Highway Research in 1931

By R. W. Crum
Director, Highway Research Board

THE REPORTS and papers presented at the 11th annual meeting of the Highway Research Board (December 10 and 11, 1931) indicate that high class research work on the problems of highway transportation and construction has reached a very impressive stage and is constantly growing. Distinct advances have been made all along the line. Those of particular interest to Rock Products readers are:

FINANCE—T. H. MacDonald, chief, United States Bureau of Public Roads, reported upon the inquiry that has been made by the Bureau of Public Roads and University of Wisconsin into the sources of road funds in Wisconsin. An important indication is that substantial savings or tax reductions could be made if the number of political units administering road work were reduced. It is planned to extend this investigation to other states as rapidly as possible.

MATERIALS AND CONSTRUCTION—The effect of hot cement upon setting time and upon workability of concrete was investigated by a number of laboratories for the Committee on Materials and Construction, and was reported upon by Chairman H. S. Mattimore. F. H. Jackson, U. S. Bureau of Public Roads, reporting the "Durability of Concrete as Affected by the Water-Cement Ratio," concluded that "a water-cement ratio of 0.8 or more is not likely to give concrete of adequate durability if the conditions of exposure are severe." A committee report on "Volume Changes in Concrete," presented by Prof. C. H. Scholer, Kansas State College, discussed the factors affecting volume changes and pointed out those phases of the problem in need of further research. This paper was supplemented by Bert Myers' report of the Iowa Highway Commission measurements of volume changes of 23 outdoor slabs, 81 ft. by 2 ft. by 6 in. Differences in volume changes due to curing processes and to character of coarse aggregates were especially noted.

Dr. E. F. Bean, state geologist of Wisconsin, of the Committee on Aggregates, discussed "Shale in Aggregates" from the geological standpoint. A principal project of this committee is on "The Significance of Sodium Sulfate and Freezing and Thawing Tests on Mineral Aggregates." A summary of available information was presented by W. V. McCown, U. S. Bureau of Public Roads.

MAINTENANCE—The committee reported that calcium chloride has been found to be a practicable agent for partially melting ice on roadways so that coarse sand or cinders can be imbedded to improve traction. Common salt is not recommended. Prof. J. S. Crandell, University of Illinois, reported that experience with bituminous mastic courses in brick pavements shows the need of at least 4% of bitumen, and that the adhesion of filler to the brick surface has been prevented by means of a coat of whitewash. The committee has important investigations in progress on "Maintenance Costs" and "Maintenance of Expansion Joints and Cracks in Concrete Pavements."

A NEW THEORY OF FROST HEAVING—A. C. Benkelman and F. R. Olmstead of the Michigan Highway Department have greatly clarified the conception of what occurs during frost heaving of soil by the experiments reported in this paper. The depth of frost penetration into the earth's surface during freezing weather varies to a marked degree, with changes in atmospheric temperature. By means of laboratory experiments it has been demonstrated that movements of the frost line, first upward and then downward, result in the formation of ice plates, which through successive fluctuations may become thick enough or numerous enough to cause excessive heaving. These results indicate that excessive heaving may occur in soil of almost any grading or texture providing an adequate supply of water is present or available. Since capillary water cannot be removed by artificial drainage, soils having textures capable of supplying enough water by capillarity to cause heaving on account of frost line fluctuations, should be removed and replaced with material that can be drained. Elimination of frost heaving in coarse materials involves only provision for drainage. These conclusions are substantiated by the fact that frost heaving was eliminated last winter at some 200 locations in Michigan by means of special treatments.

Highway Research Information Service

A series of research abstract circulars was inaugurated by the Highway Research Board this year. The object of this publication is to disseminate information concerning valuable research data in the files of the various laboratories which have not been extensively published. This is a part of the plan to provide a clearing house for highway research information, so that knowledge of the existence and location of specific data can be made available to other interested workers. It is planned to issue the abstracts at occasional intervals as the information is collected. The project reported in abstract in the first two issues were as follows: "The effect of the gradation of coarse aggregate on the density and strength of concrete," D. V. Terrell, professor of civil engineering, University of Kentucky; "Contracts let for excavation and back filling jobs as a means of preventing frost-heaving on routes to be paved this year," *Minnesota Highway News*, January 4-11, 1931; "Hot aggregates—their effect on concrete," Minnesota Highway Department; "Field tests—Concrete curing (Series 1925)," T. E. Stanton, materials and research engineer, California Highway De-

partment; "Tests on transverse and center joints in concrete pavements," reported by Searcy B. Slack, bridge engineer, *Georgia Highways,* Vol. 10, No. 2, February, 1931; "New Mexico's experience with high viscosity oil," E. B. Bail, construction engineer, *New Mexico Highway Journal,* February, 1931; "Cement-bound roads in Ireland—County Donegal," John Caffery, county surveyor; from the *Surveyor and Municipal and County Engineer,* April 10, 1931; "The Resistance of stone to frost action," W. A. Kessler, civil engineer, U. S. Bureau of Standards, New International Association for the Testing of Materials, p. 37-44, Group B 1930; "Structure of weather-resisting rocks," A. L. W. E. Van Der Veen, civil engineer, The Hague (Holland), New International Association for the Testing of Materials, p. 10-12 Group B 1930; "Surface pit survey on concrete pavements," F. V. Reagel, engineer of materials, Missouri State Highway Department; "Development of method and apparatus for flexural tests of concrete," V. L. Glover, engineer of materials, Illinois Division of Highways; "Jointless concrete roads"—description of a concrete road development in England sent by the inventor, J. H. Walker, London, England; "Rule for calculating the annual depreciation of an automobile," H. B. Shaw, director, Engineering Experiment Station, North Carolina State College; "Use of mortar-voids principle in designing concrete mixes," V. L. Glover, engineer of materials, Illinois Division of Highways; "Use of paper for curing concrete slabs," Mark Morris, Iowa State Highway Commission; "Unsoundness of certain types of rocks," Mark Morris, research engineer, Iowa State Highway Commission, *Proceedings of Iowa Academy of Science,* 1931.

As these abstracts are usually of unpublished data, copies of the complete reports are not available for distribution except as may be arranged with the authors; however, the Highway Research Board will be glad to be of any assistance possible in this.

Review of Agricultural Liming Material Situation in Ohio

By W. H. Margraf

Secretary-Treasurer, The National Agricultural Limestone Products Association

TO PRACTICALLY every producer of agricultural liming material the closing of the year 1931 will be a pleasant event, since the tonnage for 1931 will show a loss when compared to the tonnage of 1930. In addition to a decided shrinkage in volume, the price throughout the year was considerably lower than the prevailing price in 1930.

It is too early for complete tonnage figures comprising the shipments of various producers in Ohio, but if one judges from the reduction in fertilizer tonnage that has been reported, as well as what various manufacturers of agricultural liming materials that are members of our association have so far reported, the estimated 1931 tonnage will be in the neighborhood of 65 to 70% of the 1930 tonnage.

Prof. Robert M. Salter, chief of the soils department of the Ohio State University and the Experiment Station at Wooster, Ohio, reports that: "Recent figures of our rural economists indicate that the Ohio farmers' income for 1931 was 30% below 1930. It would have been much lower if it had not been for the excellent yields of crops harvested the past season. Prices of items which the farmer buys are, as a class, 15% lower than a year ago. In other words, his net purchasing power should be about 85% of last year. Of course, taxes haven't declined in proportion to other things and this will lower the latter figure."

At one of the early spring meetings of the National Agricultural Limestone Products Association the members anticipated a falling off in tonnage for the liming material, which they produce, and an extensive study was made with the Buffalo Broadcasting Corp., Buffalo, N. Y., as to the possibility of increasing tonnage through radio as the medium.

After a comprehensive survey this plan of advertising was dropped and, instead, the association carried an advertising program during the fall shipping season in a number of farm magazines with circulation in Ohio, Indiana, Michigan, Pennsylvania, New York and West Virginia. A four-page letterhead was designed carrying the trademark, or slogan, "Lime the Liberator," acquainting the farmer with the now well-known Seven Points of Profit by the use of liming material. The Seven Points of Profit, in the condensed form showing the value of lime when used for agricultural purposes, are as follows:

1. Corrects acidity. Crops grow best in neutral or only slightly acid soils.
2. Supplies plant foods. Calcium and magnesium are necessary plant foods.
3. Improves tilth. Mellows heavy soils—binds sandy soils.
4. Energizes humus. Promotes the decay of organic matter to form humus.
5. Promotes nitrification. Encourages growth both of the bacteria which make available the nitrogen in the humus and the nitrogen in the air.
6. Increases efficiency of fertilizers. Makes both fertilizers and manures more effective.
7. Counteracts soil poisons. Renders the toxic compounds of aluminum insoluble.

A more detailed description of the Seven Points of Profit was carried on the inside of the four-page folder. Many inquiries were received for the four-page folder through the advertisement carried in the farm papers and a campaign was carried on to include the trademark on each member's individual stationery, as well as the car cards that are placed on all railroad carload shipments.

A large number of four-color metal signs were distributed to the association's members who, in turn, had their dealers place them in front of their warehouses which carried the slogan, or trademark, "Lime the Liberator," and each piece of advertising carried this trademark.

The farmer, this year, was acquainted with the fact that lime did more than just correct soil acidity and I firmly believe that the advertising campaign in Ohio had its effect in creating enough interest to keep the sales in Ohio as large as they were this year.

Prediction for 1932

After considerable thought I can see no reason to expect 1932 to be very much poorer or very much better than 1931. Naturally, weather conditions will be a controlling factor. We have yet to learn as to whether or not the increased crops the farmer received this year will be the means of increasing his buying power. Increased freight rates will have a tendency to increase the price to the farmer. However, this increase will be but a slight increase in prices, as compared to quotations of 1931 which, to all appearances, are lower than they have been for many years. It appears that the only thing one can do when contemplating the tonnage for 1932 is to wait and see.

Feeds Limestone to Dairy Herds

DAIRY HERDS on plantations in the West Point, Miss., section are being fed limestone. J. E. Evans and others have been making demonstrations. The natural deposit, with a calcium carbonate content of 60 to 85% is being mixed with ordinary feeds minus the alfalfa quota.

Certain Divisions of Sand and Gravel Industry Become More Distinguishable

Different Types of Operation Have Different Places in the Industry's Scheme of Things

COLUMNISTS AND MORALISTS tell us that business depressions have their value in making us better business men and in requiring the exercise of our ingenuity and originality in finding ways and means to profit; and the sand and gravel industry could well serve as an example that such has been one of the results of the present slump, for new uses are being found even for such a commonly used commodity as ordinary sand and gravel. For example, two metropolitan sand and gravel producers have developed small but profitable outlets for "lawn sand," and a much larger market might be added if farmers and garden truck growers in many of our middle western states could be sold on the advantage of adding sand to some of their crop lands. Our heavy clay soils of the Middle West, while ideal perhaps for corn and grain crops, would produce much better truck crops if liberal additions of sand were made, for the same reason that sand is beneficial to lawns and golf courses, mainly to loosen up the soil and promote drainage and root growth.

Hard Times Promote Vision

The outstanding thing that the present year has brought home to us as editors of ROCK PRODUCTS is the fact that there are three distinct divisions of the commercial sand and gravel industry, which recent developments make clearly distinguishable, and it is equally clear that these three divisions of the industry have many points which are *not* in common and, in fact, may be in conflict with each other.

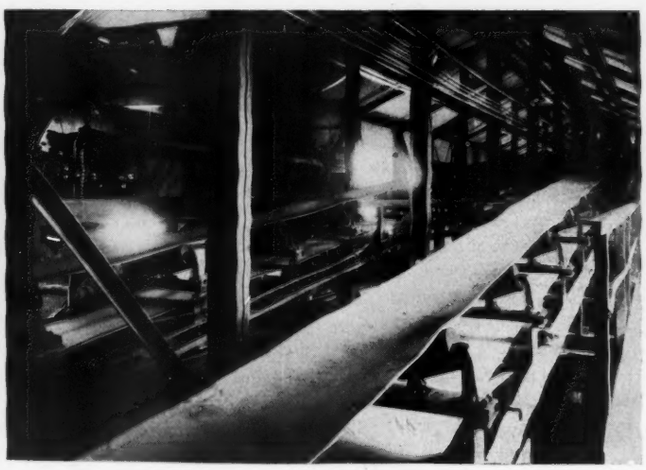
In the first division or group are plants near industrial centers and steady markets where the tendency has been to build real sand and gravel *factories*, plants which turn out great quantities of finished product not only of aggregate but such things as ready-mixed concrete, asphalt- or tar-coated gravel and, in some instances, concrete products. Such plants require elaborate washing, screening, crushing, storage and handling facilities for a dozen to 20 different sized products, and operators of such plants undoubtedly profit from constantly stricter and more complicated specifications and stricter enforcement of these specifications, because they are amply prepared to furnish whatever the market may demand for any one of a great many uses.

The second division or group of operations includes plants of a temporary or transient character in the open country where the market depends upon the construction of a few hundred miles of paved or improved highway, the construction of a few bridges, dams, hydro-electric works or other construction of like character that, when once completed, practically annihilates a market for which the plant was designed. Specifications for work of this kind can be readily adapted to the material and good concrete or other product made by proper preparation and manipulation of almost any clean sand and gravel available. An interesting type of such a transient plant that has given many established producers a lot of trouble during the last year is the so-called "tramp" dredge which has been operated on some of our middle western rivers, seeking a construction job near which the dredge can be anchored and the material prepared for that particular job; and when completed, the dredge can be moved elsewhere to seek a similar job, thus depriving established producers in the locality of the job of output which they could very legitimately have expected under normal conditions.

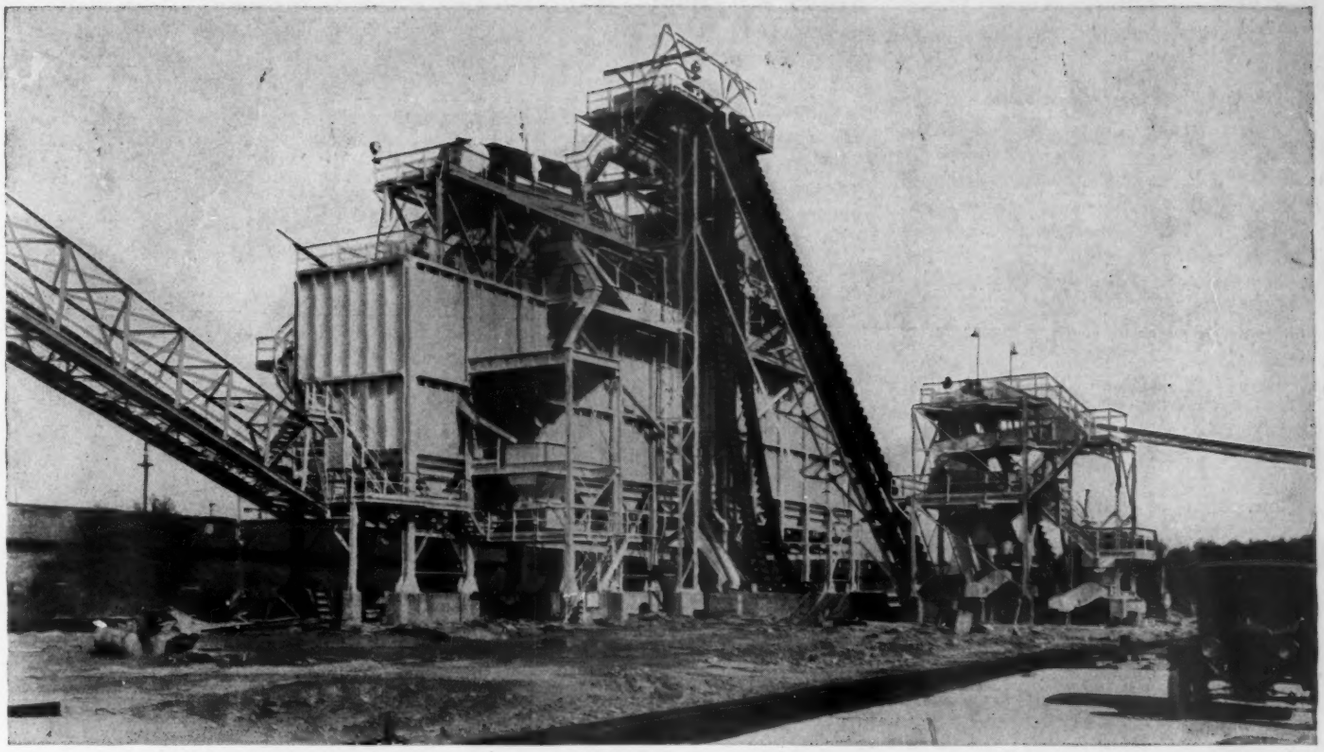
The third division or class of sand and gravel plants is the one designed to produce road gravel exclusively, and of these there are many in the middle and central west states where much of the road building during the past year has been the improvement of secondary or country roads. The product that these plants are required to produce, while it is a much higher grade material than formerly used for that purpose, can be produced very cheaply with a minimum of investment in plant and equipment.

A fourth division of the industry which we are not yet reconciled to looking upon as legitimate is the strictly movable screening plant on wheels, which is largely owned and operated by highway contractors or public highway building authorities. The time may come when such plants will have to be recognized as a legitimate part of the industry, as possibly this kind of operation may be gone into by the commercial producers, but that time is not here now.

It is obvious that present competitive conditions have emphasized the distinctions between these types of plants, because even though railway rates or transportation costs remain unchanged, the transportation cost, with a lower price for the product itself, becomes a much larger proportion of the price of the product to the ultimate con-



The above installations of conveying equipment are in new sand and gravel plants



New plant of Curtis-Hill Gravel and Sand Co., Morrisville, Penn., one of the largest built during the year

sumer; and the entirely natural normal tendency for the ultimate user, who is aware of the importance of the transportation feature, is to seek a source of supply as near as possible to the construction site. With the improvements made in the preparation of sand and gravel, sources of supply which formerly would have been overlooked as entirely unworthy of consideration are now being developed to make a passable material. This condition is likely to remain, and it seems safe to predict that the days of long rail hauls of such a commodity as sand and gravel are definitely over.

With these economic conditions already in mind, the producer and prospective producer of sand and gravel must study his markets and prospective markets with the utmost thoroughness and plan his operation accordingly. Unless he has a permanent market in thickly settled or industrial parts of the country, obviously he is foolish to invest in an elaborate plant and equipment, or even in a plant of permanent character. He would better use his energies and capital in locating and securing options on available sources of supply near prospective construction work, and definitely go to work to devise ways and means of securing his orders for material from such local sources, than to attempt to operate a single large plant at a distance, no matter how economically he may be able to operate such a plant.

Production

Production of sand and gravel in 1931 fell off between 24 and 25% as compared with 1930, and using the figures of the United States Bureau of Mines for commercial sand and gravel only, leaving out special sands such as glass, molding, etc., the production for 1931 must have been approximately 137,000,000 tons as compared with 183,000,000 in 1930. From reports made by producers in all sections of the country, the individual plant production ranged from 16 to 45% below 1930. The percentage of plant capacity utilized ranged from 37 to 51%, averaging about 40%.

Prices

Prices of sand and gravel in 1931 ranged, according to reports, from no reduction as compared to 1930 to 50%, with an average of about 20%; which, if true, is less shrinkage in price than many other basic commodities have shown. Of course, there were individual cases of particularly fortunate producers who have been little affected by present conditions, either in prices or production, but in nearly all of the industrial centers there was considerable price-cutting and a good deal of complaint that prices were below cost.

Labor

The scale of wages in the industry as a whole is about 10% less than at the peak in 1929, and about one-fourth of the operators have not yet reduced either wages or salaries, so that in this respect the sand and gravel industry is more fortunate than many others. About one-half the operators believe that there will be a slow return to previous wage scales. The other half are not so optimistic. There is no evidence of labor trouble. A few instances of restlessness were reported, but nothing of a serious nature. The percentage of labor employed in 1931 as compared with the peak year of 1929 is roughly 60%, with many reports that producers are using more men than really necessary in order to relieve local unemployment.

Maintenance and Upkeep

The general average of expenditures for new equipment, maintenance and upkeep was 72% of a normal year's expenditures, except in the East Central states, where the figure was considerably above the average. The estimate for maintenance and upkeep for 1932 is approximately the same as during 1931, although very few producers have very distinct ideas as to what the New Year has in store for them in the way of business. Obviously, expenditures for maintenance and upkeep will be largely gaged by the amount of tonnage.

As in the case of the crushed stone industry, the tonnage is a remarkably accurate guide as to the amount spent by producers for machinery and supplies. A falling off of 25% in tonnage resulted in an identical falling off in the purchase of supplies and equipment.

Such expenditures do not include investments in new plants. As noted further on in this review, there is reason to believe about as many new plants went into operation in 1931 as in any other year. Such expenditures as we include under maintenance and upkeep are those which are in a large measure cumulative. They may be omitted for a year or two, undoubtedly, in order to conserve cash at the moment, but they must ultimately be made up if plants are to be kept in condition to compete under existing conditions. Our figures also prove appar-

ently that tonnage is what causes repairs and replacements, not necessarily years of service.

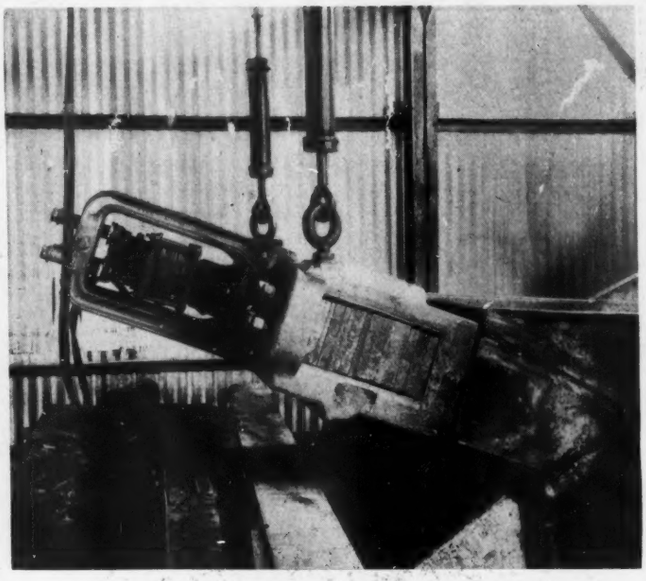
New Plants and Developments

As we pointed out in some of the general articles in the course of the year, apparently almost as many new plants were constructed in 1931 as in any previous year, notwithstanding the fact that existing plants were operating at less than 50% capacity. The reasons for these new plants have been explained before and are usually understandable when one analyzes the economic conditions of the industry and the importance of transportation costs to the ultimate consumer. By far the larger number of these new plants have been built by established producers who have gone into new territories or reestablished themselves in their old territories by building plants closer to the points of consumption. Also, there have been the usual number of replacements of old and out-of-date plants with new ones. There has been a distinct tendency for an established producer in localities where business is dull, to look around him for neighboring localities where there was business in prospect and to go and establish himself there rather than to wait for business to come to him at his old location.

Another source of new plants in the territory has been a notable tendency for building supply dealers and contractors to engage in the production of their own aggregates through their obvious desire to cut costs and to develop any department of their business that looked as though it might be profitable. Many such attempts to engage in the aggregate business have been unsuccessful and costly, but it is still a common source of new money and new organizations in the industry.

Another reason for new plants is the age-old one always in particular evidence in times like these when producers find it necessary to trim their staffs and turn loose experienced personnel. Such men with a lifetime's training and experience in the industry frequently strike out for themselves, and with new and modern plants in competition with old and out-of-date ones, often succeed over their former employers.

This is one reason, of course, why mergers are often futile, especially when handicapped by excessive charges for overhead to care for an extended capital structure. Very often the expected economies in operation and administration are more than offset by such capital charges, and if the plants happen to be old or out-of-date it is obvious that conditions are favorable to new projects, notwithstanding the over-planted condition of the industry.



Electrical vibrating mechanism of conveying-vibrating screen

Technical Developments

Probably the most notable development in the industry in 1931 was the stricter enforcement of specifications in many parts of the country, due to the fact that with the buyers in complete control of the market they were in a position to enforce these specifications and to pick their material much more freely than they had ever been able to do before. Consequently there has been a tremendous interest in equipment and methods for improving the preparation of materials, and in almost every case producers are cheerfully meeting the increased demands, and in several instances plants are becoming almost department stores in the variety of products that they are capable of producing.

The washing out and disintegration of soft particles in gravel and sand probably has received more detailed study by both users, plant operators and machinery manufacturers than in any previous year, due to the tightening up of highway specifications in many states and to the study and publicity given to tests on the durability of aggregates. Such soft particles are those that are proof against ordinary washing and screening operations but develop unsoundness with weathering.

The desire to rid gravel of such material has resulted in the use of a great many more washers and scrubbers than ever before considered necessary or desirable.

Another reason why washing out and disintegration of soft particles in gravel and sand is being given more attention than before is, as already mentioned, that sources of material which formerly had been rejected because of the presence of these impurities are now being utilized on account of their availability for construction work.

As an example of the interest in this subject, there is a gravel plant in Michigan where a type of scrubber was developed which uses steel balls to break up and disintegrate the soft material, and to this plant has been shipped in carload lots gravel from all parts of the United States and Canada to be tested for the elimination of clay, soft sandstone, shale, coal, etc. This is ample evidence of the interest being displayed by producers everywhere in the improvement of their product.

As in the crushed stone and other rock products industries, much interest is also

Newly developed crushers used at Curtis-Hill plant

being displayed in lowering power costs, and by attention to power factor and other details of their power contracts many operators are making much better deals with power companies than heretofore. There has also been increasing interest in the possibilities of Diesel engines, and in some parts of the country producers are returning to Diesel engine power as a third stage in their development — (1) old-fashioned Diesel or crude oil engine; (2) purchased electric power; (3) back to improved Diesel engine power.

Attention is also being paid to power transmission equipment and lubrication, which not only show savings in operating costs but very appreciable savings in attendance and labor costs. Modern gravel plants look so different from those of ten years ago that an old-timer unfamiliar with intermediate stages would scarcely recognize them as gravel plants.

The use of vibrating screens continues to grow both for scalping and final classification, and with but a few exceptions all new plants are equipped with vibrating type of screens for both these classes of work. The outstanding exception is the new Curtis and Hill Gravel and Sand Co. plant near Philadelphia, where rotary screens are retained for sizing but vibrating screens are used for scalping. The rotary screen still has its advocates as a combined washer and screen, and doubtless there are still many operations where it serves this purpose best, although there are now many producers who believe in entirely separating the two processes and utilizing the scrubber as a scrubber only.

The use of motor trucks for stripping and hauling from pit to plant has shown a gradual but not extraordinary development, and there are many operators who believe that the cost of maintaining suitable roadways in the pit, particularly if it is wet or damp, offsets any other advantages that motor trucks may have.

The need of a more widespread use of steel and concrete structures in the sand and gravel industry is evident by fire losses during the year. All of the new plants in our Class 1 (permanent plants near large cities) are now built of fireproof construction. The transient or temporary plant could just as well be built of steel and be of knock-down or movable character as not, and we believe that in the future we shall see a very decided tendency towards plants of this type, of possibly 250 to 1500 tons capacity per day, which in many respects will be as efficient and complete as a permanent plant.

Marketing Developments

The outstanding development of the sand and gravel industry in the field of marketing during 1931 was the establishment of central selling organizations in New Orleans, Pittsburgh, Des Moines and possibly other cities. In each instance the scheme of organization is a little different. For example, in New Orleans there was a real merger of the producing units into a holding company; in Des Moines and in Pittsburgh the organization is more in the nature of an association of independent producers for the purpose of handling sales in a single metropolitan territory only. All three apparently are operating successfully at the present time, although similar selling organizations in Milwaukee and in Portland, Ore., went to pieces during the year. It is evident from a study of the experience of such organizations that any one of a number of given types of organization will work out if the problems of personality are eliminated. They must be on a "give and take" basis, and once a producer becomes dissatisfied or extraordinarily ambitious so far as the sale or promotion of his own material is concerned, almost any kind of organization or groups of producers can be broken up or become inoperative.

Silica Benefits by Demands of Glass Container Industry

THE CONDITIONS in the silica sand industry follow closely the variations in the foundry, automobile and building industries, so that depressed conditions within those industries is reflected in the demand for silica. One exception to the general slackness of demand has been the glass container industry, which has called for the normal amount of silica for food containers and beverages.

Production and Prices

In New Jersey and the Eastern states the volume of demand for silica slumped off 53% compared with 1930, according to reports received. In the Middle West—Ohio, Illinois, etc.—both volume of business and price held up considerably better.

Prices for the higher grades of sand, with a few exceptions of rather unjustified price cutting, held up to 1930 levels, and in a measure pulled the industry as a whole through the year. In the East the price reductions were most severe, with the Pacific Coast a close second.

These price drops apply apparently mostly to inferior materials, as the decrease in volume and consequently increased costs of operation have made it impossible to decrease the prices of the better grades of sand. Plants throughout the United States operated on an average at approximately 50% capacity.

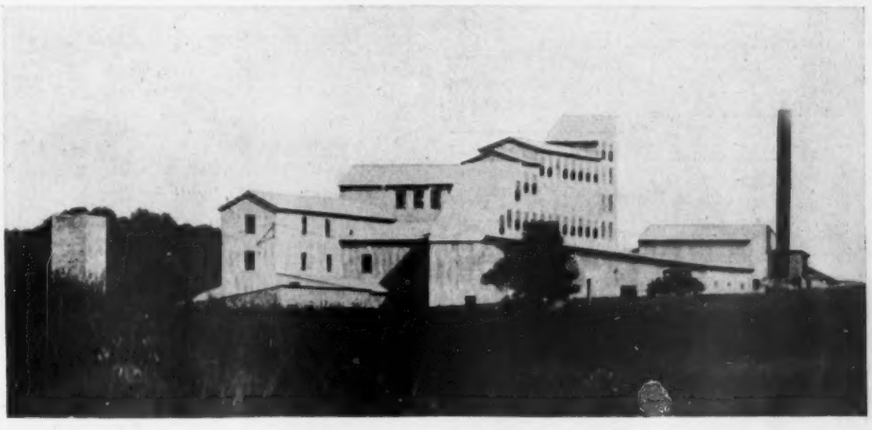
There were no new technical developments in the industry, although the gradual improvement in uniformity and quality has gone steadily forward, so that today it is possible to secure silica sands that are of a higher quality than at any time in the industry's history.

There are some technical developments under way, which are directed towards the removal of, or at least lowering, the iron content of some sands to make them available for glass manufacture. We hope to publish something on the progress of this work a little later.

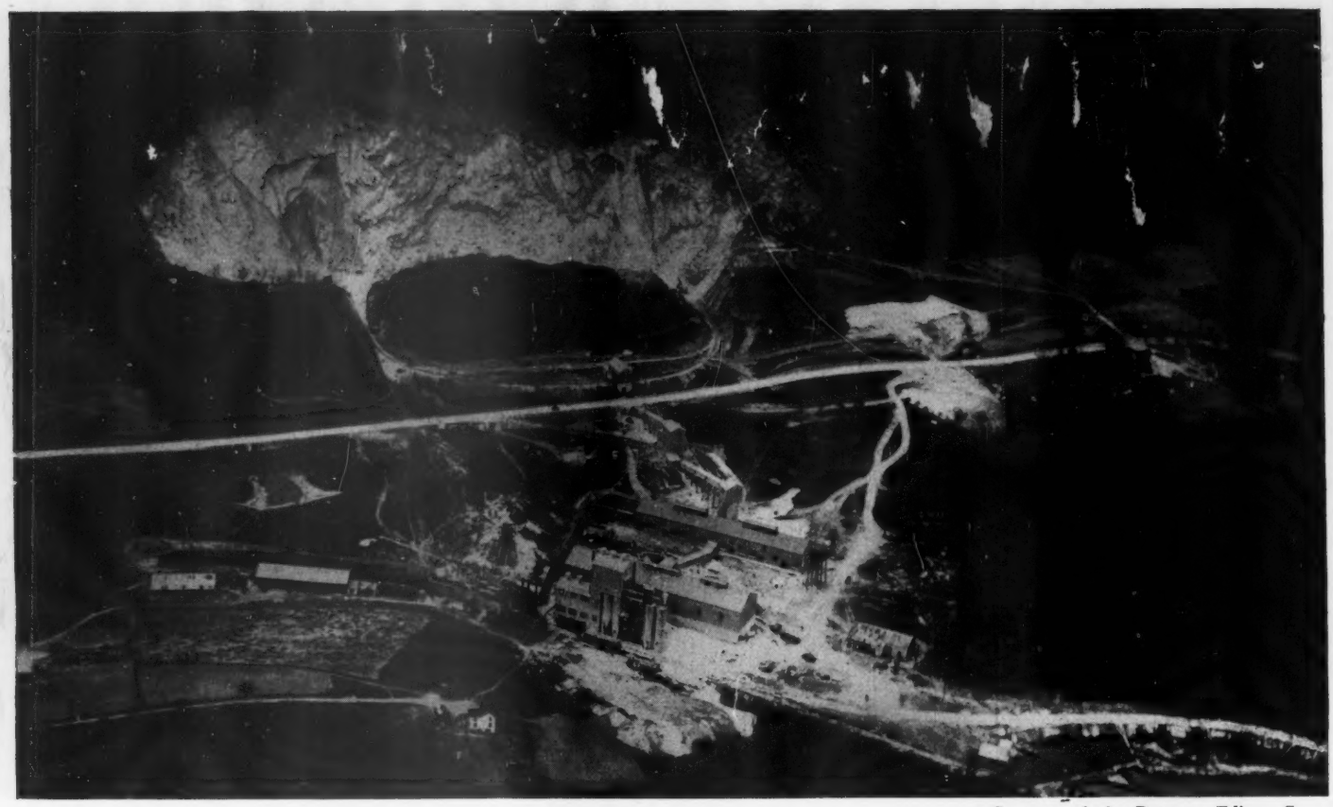
Labor

In the East wages were cut in a few instance; the cut individually ranged from 10 to 12%. Over half the reporting companies made no wage reduction.

Labor conditions in the industry are reported satisfactory to the employer; and opinion as to a quick return of more normal



New silica plant at Jackson, Ohio



—Courtesy of the Potomac Edison Co.

Airplane view of Pennsylvania Glass Sand Corp. operations near Hancock, Md.

conditions was about equally divided. There was roughly 50% of the 1929 labor requirements employed during the year. Plant maintenance for 1931 was considerably below the average of the other rock industries. It averaged about 60% of the expenditure for 1930. Indications for 1932 are for a much larger spending for this purpose, an average of about 80% of the 1930 expenditure.

The following tabulation shows the tonnage and value of silica, molding, filter, engine and furnace sand produced in 1930. These figures are from the United States Bureau of Mines report:

PRODUCTION OF SILICA IN 1930

SAND	Short tons	Value
Glass	1,849,101	$3,210,973
Molding	3,336,855	3,547,154
Grinding and polishing	1,115,915	1,613,022
Furnace	258,241	333,727
Engine	1,773,204	1,219,070
Filter	80,326	167,947
Total	8,413,642	$10,091,893

New Plants

One of the outstanding new plants built this year in the silica industry was that of the Ohio Quartz Products Co., Jackson, Ohio. The plant of the Virginia Glass Sand Co., Winchester, Va., built late last year, entered its first year of production.

The former company has a plant near Jackson for preparing abrasive, engine, and glass sand from a high silica sand and gravel deposit. The company later will also manufacture other silica products such as brick, etc. The raw material is secured a few miles from Jackson and, after being washed and sized, is hauled to the Jackson plant by motor trucks. Here the material is passed through a Bartlett and Snow dryer and sized on Hum-mer screens. Most of the elevating and conveying equipment was supplied by Jeffrey Manufacturing Co. A Symons cone crusher is used for crushing oversize.

The Ayers Mineral Co., Zanesville, Ohio, four years ago introduced its "Certified Sands" for molding and general foundry use. At that time some thought that selling sand certified for a definite foundry use was unwise —the producer taking too much responsibility. Today, this company in nine mills produces over 30 grades of molding sand, and during these times of subnormal business and increased competition the policy of merchandising accurately graded and prepared sand for a specific use has been a distinct asset to the company. At one plant, in order to secure a better tonnage from a loamy sand a new vibrating screen made by the Manufacturers Equipment Co. was tried out with satisfactory results. The Hartford Talc Co., Baltimore, Md., also announced the completion of a new mill to grind, screen and size white quartz.

Silica Rate Case

In Rock Products, September 27, 1930, and January 31, 1931, were published extensive reports of the Interstate Commerce Commission investigations on the silica rate cases. Since that time Examiner Fuller's proposed report has been filed and exceptions by interested parties were also filed, so a final decision is still held in abeyance. According to plans proposed late in 1931, oral arguments before the commission at Washington, D. C., have just been completed. It was the intention of the commission to hear these oral arguments on January 6, 7 and 8 of this year (1932).

Dust Problems

During the past year many silica producing and pulverizing companies have been made defendants in law suits by persons claiming that their health had become seriously impaired by silicosis and pneumocosis due to silica dust. The extent of these claims (one company is being sued by some 46 persons in suits aggregating $2,300,000) has assumed the extent and earmarks of a "racket."

Consequently attempts are now under way by some of the leading silica grinders to form an organization, the purpose of the group being to gather impartial information on the subject, and to collectively take such counter-legal action as is deemed desirable. This embryonic association is tentatively being directed from the offices of Robert A. Bautz, 236 North Clark St., Chicago, Ill., and it is intended to include all grinders and pulverizers of any mineral or mineral compound who may be interested in this problem.

Crushed Stone Industry Shows Distinct Progress and Trends

Operators Are Doing Utmost to Maintain Employment—Crushed Stone Plants No Longer Recognizable as Such

THE PRESENT situation and the future outlook for the commercial crushed-stone industry are far from discouraging, as we are sure the reader of this review will agree. This year we have made our comments more general and have mentioned but few operations by name—the editors trusting that this type of review, which is necessary to economize in space, will be found helpful and interesting.

Production

Production of crushed stone in 1931 apparently fell off for the country as a whole as compared with the previous year, 1930, about 25%, or considering 1930 a fairly normal representative year, the production of crushed stone is down about the same percentage below normal as is the average business. Production in 1930 was approximately 120,000,000 tons, and therefore production in 1931 was approximately 90,000,000 tons.

The greater part of this loss was undoubtedly in the railway ballast and fluxing stone markets. The stone used for highway work probably was almost equal to that required in 1930, but less of it went into concrete and other so-called first-class pavements and more into secondary types of roads where smaller sizes of stone are most in demand.

Outlook

The outlook for the crushed stone industry in 1932 depends upon the factors affecting the three major market outlets: (1) railway ballast, (2) highway and public works construction and (3) flux or furnace stone.

The outlook for railway ballast next year at this time is obviously problematical. Unless railways receive more revenue in the future they are not likely to buy much more than they did in 1931. There is one noteworthy thing, however, about the railway ballast market and that is the demand is cumulative. Railways may postpone purchase of ballast for a year or two or three, but its purchase cannot be postponed indefinitely without serious detriment to the track structure, and ultimately accumulated requirements must be purchased.

The same, of course, is not true of the flux stone market, as the demand fluctuates with the output of pig iron and steel, and the outlook for the iron and steel industry in 1932 has not been predicted at this time in any very tangible way, although perhaps it can be predicted as no worse than in 1931, with a possibility of very material improvement.

The market for highway stone for 1932 apparently will not be very far different from what it has been in 1931. It was disappointing in 1931 and considerably below expectations because of the delay in getting much of the planned work under way on account of financial difficulties in many localities and the delays caused by the minimum wage laws in a few of the states which normally do the largest amount of highway work.

Prices

Prices in 1931 followed the same trend as prices of all other commodities, after having withstood the attacks of general business conditions since 1929. Prices apparently dropped in about the same proportion as production, although in some sections of the country the drop was more than in others. These price reductions vary from 18% in the Southern states to 39% in the Pacific Coast states, with an average in the Eastern and Central states, which had the bulk of production, of about 30%.

Labor

Operating conditions for the country as a whole show that less than 50% of the capacity of the industry was utilized in 1931, and the number of employes was approximately 80% of the number in 1929, the peak year of production in the industry. This decrease of only 20% in the number of employes would indicate that the crushed stone industry has kept on a larger proportion of its men in comparison with other industries where the same shrinkage in production has taken place. This may be due to the desire to retain as large a number of employes on the payroll as possible. Usually quarries are in isolated sections of the country where it is impossible for employes to obtain other work, even in normal times, and we are inclined to believe that the retention of so large a percentage of labor on the payroll is highly commendable as a humanitarian step, rather than an object for criticism for lack of efficiency. At least one company in the East, operating a number of plants, established a pension system for employes too old to be further useful without being a safety hazard both to themselves and their fellow employes.

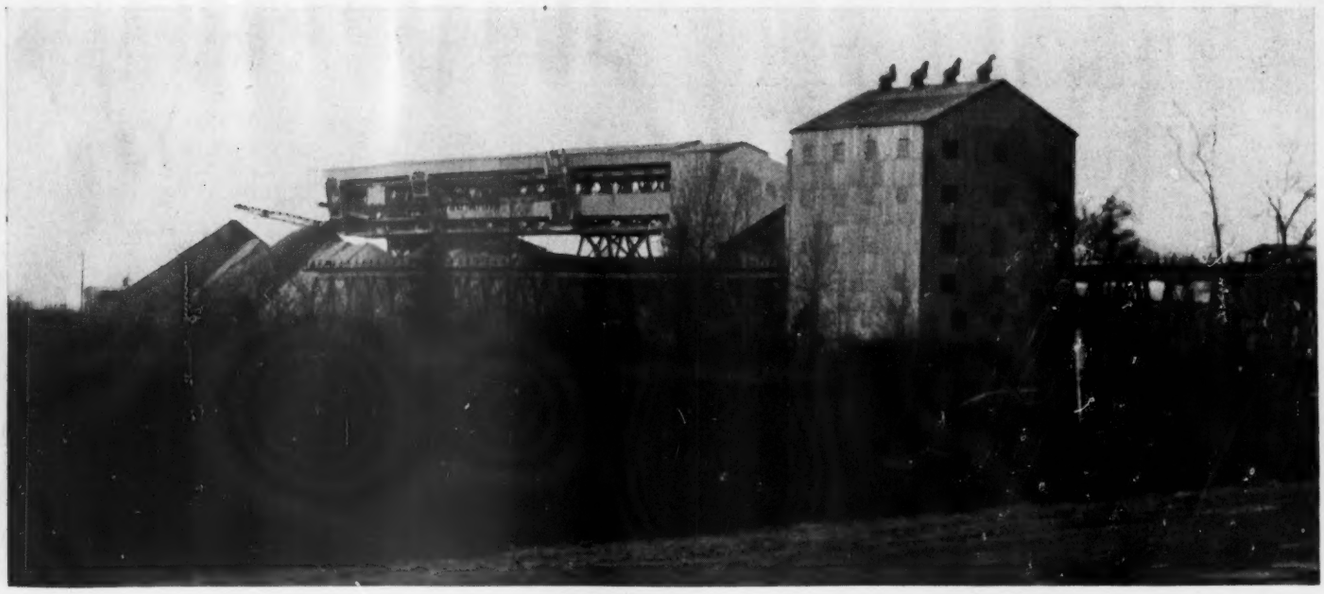
Wage scales have been cut on an average of only 13% below those in effect in 1929, which is also low in comparison with wage scale cutting in many other industries, and there apparently are at least 25% of the producers in the industry who have to date made no cuts in wage schedules whatsoever. Many producers have reported cuts only in salaried positions and not in wages, and in some instances salary cuts ran as high as 30%, which is ample evidence of the desire on the part of owners and managers to extend every possible assistance to their employes under the present emergency conditions. Only about 25% of producers expect to see an early return to former wage scales. About 60% do not look for an early return, and about 15% are non-committal or too much in doubt about conditions in general to hazard a guess.

Plant Maintenance

Expenditures for maintenance and repair of plants in 1931 are reported as an average of 72% of the amount expended in 1930 and about the same percentage is expected to be expended in 1932, although many qualified this prediction as very largely dependent on the output. In other words, production figures are an excellent indication of the amount of money spent for machinery and equipment in this industry each year. Some 30% less in tonnage brings approximately 30% less in business to the manufacturers of machinery and equipment used in quarries. However, we are inclined to believe that while expenditures for maintenance and equipment may be suspended, they are really cumulative and that the 30% deficiency of 1931 will have to be made up in 1932 or 1933, or many present plants in the industry will be entirely out-of-date, or at least not sufficiently well equipped to meet the constantly increasing pressure of competition.

Markets

As in all other lines of business enterprise, the present conditions have made better business men of many crushed stone producers and quarry operators. Much more interest is being displayed in selling methods, developing new markets, stopping small losses, and a very noticeable desire to meet even the strictest of specifications cheerfully. For example, many producers are experimenting with the production of scientifically prepared crushed stone sand, at least one even



Plant of the new Thunder Bay Quarries Co. at Alpena, Mich.

having gone so far as to apply for patents on a process that he has developed.

A noticeable trend in new plants is toward a design whereby any desired size and grading may be produced and surplus large sizes reduced to smaller salable products.

With greater opportunities to sell crushed stone for secondary road construction or for top surfacing of older pavements, many producers, particularly in the more thickly settled parts of the East, have found it expedient to add new crushing and screening equipment to make more product in sizes from ¾ in. down. Apparently the industry fared better in New England than in other parts of the country, which may be accounted for in various ways. First, we believe that New England business men are more staid, not subject to the same enthusiasm in booms, or the same dejection in depressions, as business men in some other parts of the country. Second, their business has been on an even keel or moderate level longer than in other sections. Third, they have shown real skill and ingenuity in developing new markets and in other ways applying at least a little of modern merchandising methods to their business.

Washing of crushed stone has received more than ordinary attention, largely because of the proposed changes in specifications for New York state which will require all stone to be thoroughly cleaned by washing or otherwise. Many producers believe there is considerable sales advantage in a "washed and screened" product, even though the same producers are reluctant to believe that washing will actually improve their product.

As an aid to marketing their crushed stone more and more producers are turning to the possibility of selling asphalt coated stone and to the sale of crushed stone in the form of ready-mixed concrete. In some instances the producer of stone is himself engaging directly in these sidelines or finished-product industries; in others he is leasing a part of his property to other parties with the assurance of furnishing the stone for the finished product.

Because of the stagnant condition of the home-building and small commercial building industry, the opportunity of making concrete products as a market outlet has not been much considered during 1931, but it is believed that with a pickup of general building construction crushed stone producers will give the same attention to the market possibilities of concrete building products they are now giving to highway building products. In other words, producers are becoming truly product-minded, or market-minded, which is ample promise that their future is assured.

Technical Developments

More stringent state laws in regard to size of quarry blasts and new laws pertaining to the handling of high explosives are contemplated in at least two of the Eastern states and are likely to become live subjects in all of the more thickly populated states where quarries are near centers of population or industry. In the Northeast the question is so important that the local producers have decided it worth while to employ an attorney to watch the legislature's proposed activities which are likely to seriously affect their interests. On the other hand, in less thickly populated sections the year 1931 saw some interesting developments toward larger blasting operations than heretofore tried. In a Michigan quarry a single blast was exploded in which 156 tons of high explosive was used. In a Pennsylvania quarry 12-in. blast holes are being experimented with.

In plant equipment the tendency has been toward refinements such as more attention to lubrication, use of wear-resisting alloys which are now universally recognized as cost savers, and in much greater interest in power-saving devices. In fact there is extremely live interest in every element in plant operation that will save cost, even if the saving involves the expenditure of considerable sums for further investment.

With new plants the general design and appearance is changing so radically (witness the new plant of the Kelley Island Lime and Transport Co., Rock Products, December 19) that an old-timer returning to this country after an absence of 10 or 12 years would not recognize a crushed-stone plant. They are fast beginning to assume the general appearance of any mill or factory building, all steel and concrete, entirely enclosed, painted inside and out, and otherwise made as presentable and uptodate as any modern workshops.

All phases of plant operation are coming in for a more intensive and careful study with the object of reducing production costs. Cost of purchased power is an item of considerable importance to every crushed stone producer, and particularly in the case of large operations further efforts are being made to reduce this by a better control of the maximum demand, improved power factor, or in other ways.

Unlike most of the producers in this field, the public utility companies see that all proper overhead expenses, including capital charges, are included in the rates charged for power. Since there is little hope of rate reductions, any savings in power costs must come from the two factors just mentioned and from improvements in general arrangement of plant and in power-saving equipment. This refers particularly to vibrating screens as against the older types of heavy revolving screens (which change has been progressing steadily), to conveyors equipped with anti-friction bearings, pressure lubricating systems, and to modern drives of either the V-belt or enclosed gear

One Pennsylvania quarry has been experimenting with a 12-in. drill bit

type. Such equipment not only saves materially in power required but in the matter of labor and attention.

Trucks for transportation from quarry face to crusher show increasing popularity since this system of transportation has been adopted in at least two of the new operations opened up this year, and has been substituted for other methods of quarry haulage in a number of older plants. Most of these trucks are of large capacity, 15 tons being the maximum capacity.

On the other hand, in quarries where industrial railways are used, very considerable economies and increases in general efficiency have been made by a little study of such details as track layout, attention to train dispatching, etc.

New Plants and Changes

There were about 20% fewer new incorporations in the quarry industry in 1931 than in 1930—51 against 69 in our tabulation—and from various sources it is believed that the number of company failures or plant closings at least equaled the number of new incorporations, many of which, of course, did not get beyond the project stage.

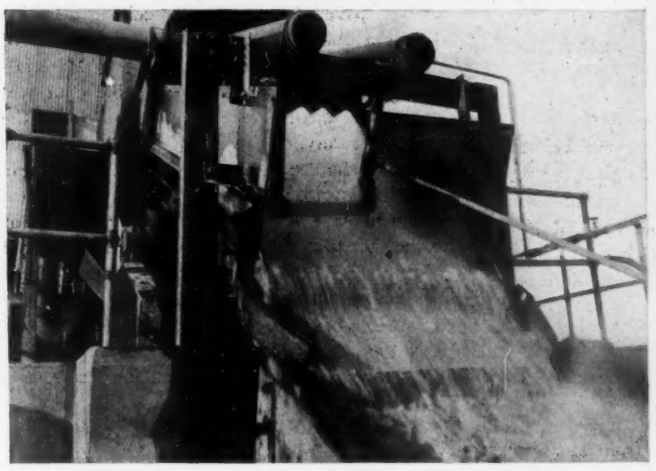
On the other hand, the industry by no means stood still, as some notable new plants were built during the year, and at least two new large producers (5000 to 10,000 tons per day) entered the field. These two are the Thunder Bay Quarries Co. at Alpena, Mich., and the Hudson River Stone Corp. at Mt. Taurus, N. Y. The first company's plant is already built and in operation, and the second is nearing completion. Besides these there were numerous smaller operations, the most notable of which perhaps is the new Bridgeport, Penn., plant of the Bethlehem Mines Corp.

There were reasons for establishing all three plants, although of course many competitive producers do not believe that they were logical or justified. They are evidence, moreover, that new plants will continue to be built regardless of statistics of overproduction or overcapacity of existing plants. When new plants can be built in any industry in such a year as 1931 it is significant of changing conditions that no producer can possibly afford to overlook, for the same changing conditions will continue indefinitely to bring new competition into the field.

The Thunder Bay Quarries Co. is a waterfront plant on the Great Lakes designed to engage primarily in the flux and industrial limestone business, which has become a very big factor in the Great Lakes cities. It would be difficult to prove it was necessary to add so much new production, but this development does give a large consumer its own or an independent source of supply. The Hudson river plant is also a waterfront plant designed to serve the metropolitan area of New York City, which, while admittedly being served adequately at present, is not so competitive a market as its size justifies—the promoters doubtless believe. The Bethlehem Mines Corp. plant at Bridgeport, Penn., was built primarily to supply the Bethlehem Steel Corp. with dolomitic furnace stone, although it will of course supply some commercial crushed stone as well. Here, then, are three separate and distinct reasons for new plants, and they are reasons that will always have influence in the establishment of new plants in the future.

Most of the other new plants in the industry, so far as we have been able to determine, were built close to highway construction projects or closer to other market centers in order to quote lower prices by saving in the cost of hauling, and while many of these are not elaborate, it is obvious that such plants fill a distinct place in the quarry industry and that they can make a product entirely satisfactory for the purpose for which they are designed.

These smaller plants are not movable plants in the sense that they are on wheels and portable, but they are usually of the



At the new Bridgeport, Penn., plant of the Bethlehem Mines Corp. vibrating screens with high pressure sprays are used and also heavy mining type hoists

all-steel construction type which can be knocked down and reassembled at a new location with comparative ease. Of course it is much easier to move a plant than a quarry, and it is doubtful if this type of plant in the crushed stone industry has the same future as a plant of somewhat similar design in the sand and gravel industry. In both industries commercial producers in sparsely settled states in the Central West and Far West must, if they intend to hold the highway construction market, look into the possibilities of serving these markets from small, more or less temporary, plants with the shortest possible hauls.

Another factor in the establishment of relatively small capacity operations, which present conditions favor, is the low wage scales now in effect and the large surplus of labor available. This makes it possible to return to hand-loading operations and small crushers where two or three years ago this kind of an operation would have been very uneconomical and inefficient.

Unfortunately, present unemployment conditions are encouraging some towns, cities and counties to attempt to produce their own crushed stone from small hand-labor operations. These are seldom or never justified from an economic viewpoint, however commendable the intentions. From a recent experience in Virginia it is believed that such public authorities can be prohibited from the production of crushed stone for general sale and distribution as an activity beyond their charter rights.

Developments in Highway Construction and Highway Materials

As Viewed by a Materials Engineer

By P. J. Freeman

Chief Engineer, Bureau of Tests and Specifications, Department of Public Works, Allegheny County, Pittsburgh, Penn.

DURING THE YEAR 1931 many material producers have developed new products and also endeavored to extend the use of old products into entirely new fields and uses. The restriction of construction activities has made this both necessary and possible, and material engineers have had an opportunity to study the products submitted and also take stock of the successes and failures of their older construction projects.

Durability of Concrete

The durability of concrete in service has received unusual attention by highway and bridge engineers and also by technical committees of various engineering organizations.

These studies embrace the durability of the aggregates, both fine and coarse, and also the importance of the richness of the mixes, particularly the mortar portion of the concrete.

When portland cement began to replace natural cement, enthusiastic salesmen and engineers started to talk high strength and lean mixes as equivalent to the richer mixes used with natural cement, until the amount of portland cement being used in concrete was entirely inadequate for satisfactory durability. It would appear that we are again facing a somewhat similar situation on account of the improvements in the strength of cement, particularly at early periods. Some engineers have failed to remember that adequate strength for the purpose is not the major factor in designing a concrete mixture and that a concrete meeting every strength requirement may, because of a deficiency in cement, lack the necessary durability in service. Undoubtedly the richness of the mortar vitally affects the durability of concrete, and information has been presented which tends to show that a rich mortar may produce a durable concrete even though the aggregates be not of the best quality.

The durability of stone is getting a searching study by the Committee on Correlation of Research in Mineral Aggregates of the Highway Research Board through the cooperation of the U. S. Bureau of Public Roads in furnishing a full-time engineer, who is making the investigation. A progress report was presented at the recent meeting of the Highway Research Board and a comprehensive report may be expected next year. In addition to the actual soundness of the aggregates, the volume changes of such material is also receiving careful consideration.

Fine aggregates are also getting a larger share of study than ever before. Soundness tests for fine aggregates are being developed and material engineers are beginning to look at the fine aggregates with a degree of suspicion hitherto unknown. These suspicions may have been unfounded, but nevertheless the producers of fine aggregates will have to be prepared to show that their materials are like Caesar's wife—above suspicion.

Crushed Gravel

Some gravel producers are beginning to furnish a crushed product that is practically 100% crushed material and one which is hard to distinguish from crushed limestone. Such materials may become a strong competitor of crushed limestone in certain localities.

Low Cost Roads

Many sections of the country are building the so-called "low cost road," which utilizes unwashed gravel, run-of-bank slag, red-dog, cinders, and the output from stone quarries not suitable for concrete pavements. This development of cheaper road materials has placed a severe handicap on the producers of high grade aggregates on account of the decrease in the construction of concrete and high type bituminous pavements, and the impossibility of competing in price with the materials which are acceptable to the builders of the cheaper types of roads.

High Early Strength Cements

The producers of portland cement appear to be giving considerable study to the development of high early strength cement, and several companies have placed what is claimed to be high early strength cement on the market during the past year. Engineers are studying the uniformity of these cements and also desire to learn something of their behavior at later ages.

Hot Cement

The subject of hot cement as affecting the setting time and surface checking of concrete pavements has been receiving attention and a sub-committee of Committee C-1 of the American Society for Testing Materials is studying the problem. Reliable data will be appreciated by the committee showing the effect, if any, of the use of hot cement in the field. The use of hot cement does not appear to be a serious problem in the colder regions and under average conditions, but in view of the fact that some municipalities have placed a maximum temperature requirement in their specifications it is desirable to know the facts, particularly in the Southern portions of the country where the temperature conditions are high during the summer months.

Cold Bituminous Mixtures

There has been unusual activity among the producers of bituminous materials of both asphalt and tar. Mixtures are being pre-

Airplane view of the Bridgeport, Penn., plant of the Bethlehem Mines Corp. This shows the incline skip from quarry to primary crushing unit and
This washing and screening plant produces commercial aggregates and flux stone, and embodies many m

nes Corp. This shows the incline skip from quarry to primary crushing unit and gen
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Photo by Wood Aerial Surveys, Inc., Philadelphia, Penn.

nit and general arrangement of the entire plant. The large building with the dark colored roof is the machine shop and office. nany modern features. The plant at the extreme right is that of the Union Paving Co.

pared in regulation asphalt plants and in specially constructed plants by several relatively new processes for cold application. Base and wearing courses are being built with these cold mixes with a degree of success not hitherto generally obtained. Both fine and coarse aggregate type mixtures are available for the wearing surface, and it appears that cold laid pavements have prospects of replacing much of the present hot mixed types.

There is also great activity in the development of special equipment for manufacturing cold mixes at the roadside or on the road. Some of this equipment is designed for use with emulsified asphalt or tar, while other machines employ the usual varieties of tar or asphalt.

Some of these machines will take the aggregates from truck or pile and thoroughly coat them with bituminous material and place the mixture on the sub-grade, others require the use of a truck to transport the mixture to the subgrade, but the development of such equipment represents a very important contribution to the technique of highway construction.

Improvements have been made in bladers and maintaining machines so as to make them better adapted for the construction of so-called "mixed-in-place" roads, which are increasing in popularity.

Emulsified Bituminous Materials

Emulsified materials are also receiving a very large amount of attention, but unfortunately up to this time the American Society for Testing Materials has not developed a specification which is available for use by municipal engineers, and until general specifications are developed the use of emulsified products will be restricted to those engineers who are familiar with such materials, but undoubtedly we may look forward to a large increase in the use of emulsified materials in road construction, maintenance and repair.

Tar Specifications

Until recently most testing engineers were satisfied with their knowledge of what they have always called "tar," but recent developments have given the specification writers and the material engineers a rude shock.

Certain materials are now being made from petroleum which as regularly produced or by special processing can be made to comply with the existing high carbon or low carbon tar specifications.

Until their characteristics are better known and value in service proven, many material engineers feel that such materials should have separate designations and specifications, but the preparation of such specifications is complicated by the fact that the characteristics of the old and new varieties of materials, as determined by the usual methods of tests, are in many cases overlapping. Special tests may have to be developed before new specifications which are entirely satisfactory can be formulated. Activities along this line have been started by the producers and consumers, and with the help of the Association of State Highway Officials and the American Society for Testing Materials satisfactory specifications should be developed during 1932.

France Stone Co. Laboratory Aids Both Stone and Lime Sales

By Herbert F. Kriege, Ph.D.
In Charge of Tests, The France Stone Co. Laboratories, Cleveland, Ohio

SOMETIMES there comes an attack of reticence when the request for an annual review presents itself, the reason being that no one cares to admit what he has *not* discovered in his laboratory, and often he does not care to reveal what he has found. However, there is no such reticence in mind as I outline briefly some of our activities during 1931.

Scientific Grading of Crushed Stone

The activity specification writers have shown in revamping current aggregate specifications has been a matter of particular interest to our laboratory this year. This is especially true with regard to the change from the single coarse aggregate to the divided coarse aggregates for concrete. We have been able to assist several cities, counties and states asking for suggestions pertaining to these matters. Naturally, we have been pleased to give what help we could, since it is evident that any improvement in specifications will work to the mutual benefit of producer, consumer, and the engineering fraternity as well. In each case the same suggestions have been offered, namely: that a straight-line grading be followed with the break occurring about midway between the extreme sizes. In this way the aggregates are divided about equally by weight, which greatly assists in the efficient handling of these aggregates in the field. These gradings have been recognized by both the Federal Specification Board and the American Society for Testing Materials.

THE SUGGESTED GRADING OF THE DIVIDED AGGREGATES

A	
Passing 2-in. square	90-100%
Passing 1½-in. square	35- 70%
Passing 1-in. square	0- 15%
B	
Passing 1-in. square	90-100%
Passing ½-in. square	25- 60%
Passing 4 mesh	0- 10%

We have had opportunity to observe the effect of dividing coarse aggregate, ranging from 2 in. to ¼ in. in size, broken at 1 in., in the construction of several stretches of pavement this year. In every instance the results have been highly satisfactory and pleasing to the contractor as well as the engineer. The straight-line grading is not only the best grading as far as crushed aggregate is concerned, but it has also the important economic advantage of being the same grading which is produced in the crushing operation as well.

Control of Lime Manufacture

During the past year considerable progress was made in the control testing and research in the line of production of chemical and finishing limes and hydrates. While admitting that no minute yard-stick has been developed for estimating the almost immeasurable differences between the various degrees of satisfactory behavior of finished limes, some very definite correlations between the test data themselves and between them and practical field problems have been made.

One of the fields in which the lime question is always alive is that of the masonry mortar. Several investigations dealing with the important properties of masonry cements, such as workability, non-staining tendencies, strength, and shrinkage, have been conducted both with and without the presence of suitable limes. One important observation made during this research is that lime is the most satisfactory plasticizing agent in masonry cements because it is efficient, stainless, mixes readily and is economical.

Bituminous Mixtures

During this year some progress has been made in the investigation of bituminous mixtures containing coarse aggregates. To this end a machine was developed which consists of the Dorry hardness apparatus accommodating test specimens 2 ft. in diameter and of any thickness desired, upon which two wheels revolve under any desired load. The test specimens can be fabricated in the laboratory and be compacted to any desired de-

gree in the test machine, or they may be actual pavement samples secured during the process of construction by having a suitable disc placed in the pavement base, upon which then the bituminous pavement is laid. Likewise, samples may be taken from old pavements of known service record for further comparison. The observations thus far made measure the change in the compaction of the specimen due to rolling and also to the action of traffic, its vertical deformation leading to rutting, its linear deformation or shoving, etc. The measurements under load are made over a temperature range to determine the variations in stability due to thermal change alone. Such wide differences have been found in the types of bituminous pavements so far tested that we believe the machine is sensitive to a point of detecting rather minor variations in the characteristics of either the binder or the aggregates. This is adding materially to our knowledge of the factors controlling the durability and stability of bituminous mixtures containing coarse aggregates.

Sampling Stone

The topic of sampling seems to belong to anyone, and interest in the material sampled is no personal requirement. In fact, most proposed methods have come from sources other than the producers. It seems in order, therefore, for someone interested in the material to make some suggestions covering the methods of sampling mineral aggregates.

Ledge samples cannot truly represent crushed aggregates, since such samples have not passed through the blasting, crushing, screening and washing operations which may appreciably alter the general character of the material. In the control test and the research problems of the France Stone Co. Laboratories we have used samples from the finished product as much as possible, avoiding face or ledge samples as being nonrepresentative. The following plan has been used at more than 20 stone and slag plants with highly satisfactory results:

A 3x3-ft. square frame of 2-in. lumber is placed on the side of the latest storage pile of 3- to 4-in. stone or slag at five places equidistant horizontally and staggered vertically. The entire surface material in the frame *one layer deep* is carefully removed and placed in a suitable container. The combination of the five individual samples thus taken is quartered down to approximately 100 pieces. This quantity of material is sufficient for the hardness and toughness tests (in quadruplicate), standard abrasion (in duplicate), sodium sulphate soundness (10 pieces of 200 g. each), absorption, apparent specific gravity, chemical analysis, etc.

Sampling Quarry Ledge

Where it is desired to know the physical properties of individual ledges in the quarry face the same process of sampling is followed except that the combination of five individual samples is not quartered but is separated into the various types of material by visual inspection. The weight of each type of stone differing from the others by color, texture, crystallinity or apparent physical property, is then determined and its percentage in the stock pile calculated. Specimens of these individual types are then taken in the quarry, located in the quarry face, and the amount of each constituent present in the face determined by measurement. It is often the case that the percentage of an individual ledge or constituent in the quarry face does not correspond with the percentage found in the storage pile. The reason is that the quarrying and crushing operations accomplish a selective effect, namely, a survival of the fittest. Thus it is that frequently soft ledges disappear almost entirely from the coarser sizes of aggregate and pass into the fines because the resistance to crushing is so small. Certainly the engineer using these several sizes of aggregates should be much more concerned over getting the true picture of the aggregate he intends to use than some information of the quarry face from which the material may have been produced.

By the above method of sampling we have been able to know the physical values of our numerous plants' products either in terms of the ledges as they appeared singly, or as part of the whole face, or as part of the products actually produced. In many cases a very appreciable difference has been noted in the same quarry on samples calculated to these three different bases. For example, one quarry showed an average hardness, based on the quarry face composition, of 16.66, while based on the stockpile composition the value was 17.69, due to the practical elimination of a softer stone during the plant operations.

It is well to note here that the hardness and toughness values of materials sampled this way from storage run slightly lower than fresh parent material taken from the constituent ledges would indicate. This is entirely logical, since the crushed material has been subjected to a series of strenuous treatments in the preparation for its commercial use. Since, however, it is the commodity which is bought and sold we feel all the more sure that the tests should be made on the finished product.

The fitness of the finished product for his particular purpose is the *engineer's* business; the source of the material and the problems of its preparation for sale constitute the *producer's* business. If a person wishes to buy a quarry, let him inspect and test the quarry; if, however, only the finished product is his need, let him confine his attention to that, since nothing else counts.

Miscellaneous Laboratory Work

There has been opportunity in the past 12 months to further the work previously begun along several lines, as in the manufacture and use of limestone sand for concrete and other purposes, the development of suitable test procedures for the accelerated sodium sulphate soundness test, and further development of the application of the chemical method for determining the cement content of concrete. Considerable attention was given to the production of closely sized washed dolomitic stone to be used as a flux in the manufacture of glass. The modified abrasion and several modifications of the standard abrasion test for stone have been given attention, with the hope of improving these tests in the line of making their results more easily duplicated. Filter-bed stone and slag, also, have been given special attention.

No review of the activities of this laboratory would be complete without a frank statement regarding "ghost shooting." Ghosts may be imaginary, but they can become very important commercially when they are deluding the minds of customers and striking fear into their hearts. When a man or an organization has bought a certain material for many years and has used it with perfectly satisfactory results all these years and suddenly sees a "ghost" hovering over this material, his interest in the further purchase of this material takes a decided slump. That "ghost" may be a single hardness or abrasion test run on the stone sample in some distant laboratory or some bit of hearsay breathed out in an unguarded moment in a group of pseudo or real engineers. Perhaps it is a finger of suspicion pointing at some *possible* weakness, though this finger trembles with the uncertainty of its own pointing. Of these things "ghosts" are made. If the truth were known, entirely too much time has had to be spent in leading some timid customer, often a well-versed engineer, past some familiar corner which he has been told now contains a "ghost." Caution is a manly virtue, but fear of ghosts is one of the vices of ignorance.

We have completed this month a review of the research work of the past five years. This has been no small task, but we feel the effort has been well worth while. The correlation of isolated problems, each of which when solved served a purpose, has given these research data double worth. It is hoped that a portion of this information will reach the users of aggregates through the medium of this journal.

Test Containers for Shipping Rock Products

THE Great Western Railway of England has recently been conducting experiments with a new type of container with a view to securing a more expeditious and efficient system of dealing with inland stone, gravel, limestone and coal traffic.

Experience gained in the use of a set of six containers designed to fit a freight car and a standard motor truck, and to be easily transferable for delivery direct to the owner, has proved that material advantages are obtainable in the speedy and economic discharge of the contents of a freight car. Under suitable conditions containers can be transferred at the rate of 45 tons per hour.

Lime Industry Beginning to See Possibilities and Opportunities

Has Aroused National Interest in Mortars Rich in Lime; Has Developed New Products

THE LIME INDUSTRY of the United States recorded more real progress in 1931, in our estimation, in spite of the current business conditions, than in several previous years. First, through the efforts of its National Lime Association it has made a notable advance in re-establishing lime mortars, or mortars rich in lime. Individual lime manufacturers have exhibited real initiative in the development of new products and new uses for lime. Prices have apparently touched bottom and increases may be expected.

In our review of the lime industry a year ago we laid considerable stress on the possibilities available to individual manufacturers to cultivate good-will and build up new business for industrial uses of lime through the employment of a technical contact or service man. Such a man, we pointed out, could study the customers' needs, requirements and processes, and then if possible see that the lime offered met all the requirements. At least one lime manufacturer read and acted on this suggestion; and he was greatly pleased with the results.

His service man was everywhere received with open arms. He visited a steel mill where his company's pulverized lime was being used with great satisfaction, and not only was able to make some suggestions but learned some good sales arguments. He visited a nearby steel mill of the same steel company and found the superintendent there using a lump lime from a remote source with very little satisfaction. In spite of the fact that the two superintendents were in the same organization, the second did not know of the satisfactory use of pulverized lime by the first; he is now using this lime too. On another occasion the service man found a user of lime for a special purpose who wanted an exact percentage of magnesia. He could not find a lime on the market that could promise to supply a lime with this percentage uniformly. The service man's lime company was easily able to do this by accurately proportioning a mixture of pulverized high calcium lime and pulverized dolomitic lime, the process being easy, since the two limes were uniform in composition and were regularly made and stored in separate bins. Automatic weighing and proportioning machinery did the rest. And so we might go on. Here is an example of a lime manufacturer who believed the customer had a reason for asking for a certain lime, found out just what he really wanted, and did as any other live manufacturer would do, made it for him—needless to say at a profitable price.

Another lime manufacturer has developed and placed on the market a "waterproof masonry lime," several have developed mixtures of slag, cement or other materials and lime and placed the mixture on the market under a brand name for masonry mortar. A Florida lime manufacturer has developed a special fertilizer mixture containing manganese. We presume there are similar activities, but these are enough to suggest that manufacturers are at last beginning to realize that lime has possibilities.

Production

The lime industry, along with practically all other industries, showed a further decrease in production in 1931 from the preceding year, operating at a little over one-third capacity as against something less than one-half capacity for 1930.

According to figures of the Bureau of Mines the total production of lime in 1930 was 3,384,000 tons valued at $24,950,000. Producers report a loss of tonnage compared with 1930 of 30%, which would give for 1931 an estimated production of 2,370,000 tons. The reports as to the value of the product show a falling off of 28% from the preceding year, which would give an estimated value of $18,000,000. This would indicate in spite of the further decrease in production a slight increase in unit price. In other words, the figures for 1930 show an average value of $7.37 per ton as against an estimated average value of $7.60 per ton for 1931.

Whereas normally about one-half of the lime tonnage goes into construction, the partial distribution figures for 1931 indicate that approximately 63% was used for industrial purposes; 24% in construction; and 13% for agriculture. This of course reflects the general slump in building construction.

Two plants, both in the Pennsylvania district, reported more production than for the preceding year and three plants in other sections reported no change in output for the year, but the balance all reported reduced outputs ranging up to 75% in one case and averaging 30%. The Pennsylvania district indicated the least reduction, an average of 15%, while Virginia on the other hand showed a drop of 50%.

Labor

Although wages had been pretty generally upheld during the previous year, 1931 brought reductions averaging 13% below the scale of the peak year, according to the information available. The wage scales were maintained by 15% of those reporting, while 85% made reductions ranging up to 33% in one case. However, in the case of 60% of those reporting, the reduction was only 10% or less.

The employment given to the men in the industry ranged from a reported 20% up to 100% (the latter in one case only), with an average of 60%, so that the employes' earnings would seem to have been only a little more than one-half those of more normal years.

Outlook

The producers are not generally very optimistic about 1932. Slightly more than one-half of those reporting expect no improvement during the first half of the year but look for a gradual improvement during the latter part of 1932. A little less than one-half look for no change during the present year, while a few see demand and at even lower prices.

In spite of the unprofitable conditions of the past year the plants have been generally kept up and some improvements made. Producers indicate that 70% of normal expenditures have been made for maintenance in 1931 and estimate that the expenditures will be somewhat greater in 1932.

New Plants and Developments

New incorporations in the lime industry noted in our pages during the past year total 8 with a total capital of approximately $1,000,000, a reduction both in number and amount from previous years.

Some of the developments for the year were: The Idaho Lime Co., Evans, Wash., rebuilt its plant which had been destroyed by fire. The equipment for the new hydrating plant, including a Clyde hydrator, was furnished by the Blaw-Knox Co. and the plant was erected under the supervision of C. J. Jones who acted as erecting engineer. The Ste. Genevieve Lime and Quarry Co., St. Louis, Mo., carried on the remodeling and improving of its plant at Ste. Genevieve, installing a skip system and an electric car on top of the kilns for charging the raw material, as well as other equipment. Whiterock Quarries, Bellefonte, Penn., is increasing its capacity by the building of four

additional kilns. The New Process Lime Co., Tucson, Ariz., constructed a new one-kiln plant. The Valley Lime and Power Co., McMillin, Wash., installed new machinery for the preparation of agricultural lime. The Louisiana Lime and Stone Co., Bastrop, La., was incorporated for $100,000 and announced that a 100-ton per day lime plant would be constructed. The California Lime Products Co. purchased limestone property near Towle, Calif., and announced that a plant would be constructed near Sacramento. The Auburn Chemical Lime Co., Auburn, Calif., was incorporated for $200,000 and announced that a plant would be constructed. The Chieftain Marble and Lime Co., Enterprise, Ore., was incorporated for $100,000. The Dixie Lime Products Co., Ocala, Fla., developed a new lime product known as Liman, a lime-manganese fertilizer. Dry Refrigeration, Inc., started construction of a $150,000 lime products plant near San Bernardino, Calif. The East Texas Shore Lime Production Co., Wilmington, Del., was incorporated for $300,000. The Florida Lime Co., Ocala, Fla., plans to rebuild its hydrating plant which was destroyed by fire. The Franklin Lime Products Corp., Newton, N. J., was incorporated for $75,000. The Hi-Way Lime Co., Pebble, Idaho, started up a new lime plant. The Lexington Products Corp., Richmond, Va., was incorporated for $300,000 to produce lime and by-products. The Canadian Gypsum Co., Ltd., acquired the Standard White Lime Co. of Guelph, Ontario.

Experiments are being conducted in calcining limestone in electric furnaces, which process is expected to produce lime at a cost comparable to gas or coal fired kilns and also to permit the taking off of pure carbon dioxide as a byproduct.

Pulverized quicklime, which has had such popularity on the East coast, is understood to have also been put on the market very recently on the West coast, particularly in San Francisco and Seattle, by the United States Lime Products Co. and the Roche Harbor Lime and Cement Co.

The status of the Ohio finishing lime district is given in a separate review.

The trend of the lime industry over the past ten years as to production, value of product and number of plants is shown in the accompanying table which is taken from the U. S. Bureau of Mines figures.

No immediate relief seems to be in sight in the way of higher prices for the product. The low prices of the past three or four years have been the natural result of a lack of cooperation on the part of the manufacturers to uphold prices in the face of lessened demand and excess productive capacity and will in all probability remain until such time as increased demand starts them upward.

The finishing lime branch of the industry has probably suffered the most from price cutting, with lower prices prevailing than ever before, due in part of course to the extreme depression in the building construction field. Some manufacturers feel that a merger of those engaged in this branch of the business is the only solution and efforts have been made along that line but without success so far.

LIME SOLD IN THE UNITED STATES, 1922-1931

Year	Number of plants	Tons sold	Value	Average price per ton
1922	530	3,640,000	$33,255,000	$9.15
1923	467	4,076,000	39,993,000	9.85
1924	450	4,072,000	39,596,000	9.75
1925	450	4,581,000	42,609,000	9.30
1926	435	4,560,000	41,566,000	9.15
1927	417	4,415,000	38,638,000	8.75
1928	411	4,458,000	34,450,000	8.20
1929	381	4,270,000	33,479,000	7.85
1930	375	3,384,000	24,950,000	7.37
1931	.....	2,370,000*	18,000,000*	7.60*

*Estimated.

Review of the Finishing Lime Industry in Northern Ohio

By Henry W. Hess

Consulting Chemical Engineer and Vice-President, Arnold and Weigel, Inc., Woodville, Ohio

IN REVIEWING the developments during 1931 in this particular division of the lime industry we are immediately faced by the lack of actual development during the period. Also, an analysis of present conditions in this district is difficult because government and other statistics on production and prices include the production tonnages and prices of the entire state of Ohio.

However, a review of past developments will help to explain the conditions existing in 1931.

In 1915 there were seven plants producing finishing lime, which number had grown to 12 plants in 1931, of which 11 were in active operation. The growth and development of these various plants is shown in the accompanying graph. The table shows the number of vertical and rotary kilns of all the plants and the corresponding approximate maximum productive capacities for each year of this period.

The tonnages in all cases are given in tons of hydrate, from both vertical and rotary kilns, representing the possible burned lime capacities per day figured as hydrate.

From 1920 to 1926 an extensive building program developed and keen competition ensued. In 1925, when the peak of production and sales was reached, the price had already started to fall and has continued to fall until now, with an extreme lowering of price, lowered production and increased cost of production, this division of the lime industry is facing a serious situation. It is questionable if the sales today equal 20% of the possible maximum production.

DATA ON OHIO FINISHING LIME PLANTS

Year	Number of plants	Number rotary kilns	Number vertical kilns	Total capacity, tons per day
1915	7	1	190	2320
1916	8	1	210	2560
1917	8	1	210	2560
1918	8	1	210	2560
1919	8	1	219	2660
1920	9	1	225	2730
1921	9	1	225	2730
1922	9	1	245	2960
1923	9	1	250	3050
1924	10	1	289	3470
1925	11	3	307	3920
1926	11	3	323	4110
1927	12	3	343	4350
1928	12	3	331	4200
1929	12	3	333	4230
1930	12	3	333	4230
1931	12	3	333	4230

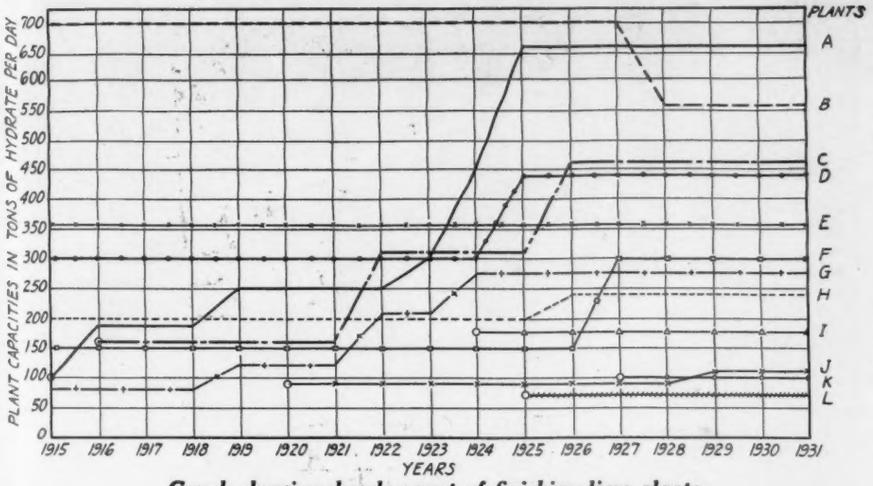
Referring to the chart, it is interesting to note that plant B during a 16-year period has not changed its kiln capacity except for a decrease in 1928, when a battery of kilns was discontinued and torn down.

Plant E operated during the entire interval without much of any change in capacity, except the remodeling and rebuilding of its present kilns. No new kilns were added.

Since 1920 four new plants have entered the field, only one of which showed an increase in plant capacity, and that only a small increase.

It is quite evident now that the promise of large tonnage some 10 years ago caused a considerable overdevelopment, with a consequent cutting of prices in the face of decreasing production and resulting in an increase in production costs.

This condition will be relieved to some extent by a general upturn of business, but even under such conditions the industry must be stabilized, as present sales are seasonal, and plants have been built for peak load production. This particular condition must be relieved by an expansion of lime sales and the adaptation of lime to other industrial



Graph showing development of finishing lime plants

uses, so that plants may operate on a more normal and continuous cycle. To overcome this condition resulting from the present overbuilding of the industry it is evident that consolidation into fewer organizations, together with intensive sales research and fundamental scientific investigations into manufacture are necessary to increase the uses of lime in industry and find new applications for it.

During the last 20 years some technical work has been carried on in certain of these plants, but most of it has been along the line of plant control of the products already being produced, and the holding of these products to certain fixed standards.

Small organizations cannot, of course, afford to promote the actual development of scientific data necessary in the industry, and even if such efforts were made in small plants, unnecessary duplication would ensue. A constructive scientific organization should consist of geologists, chemists, chemical engineers, physicists and engineers. Few industries now operating on as large a scale as the lime industry are as lacking in the real scientific principles underlying that industry as is the case generally of the manufacturers of lime and lime products.

Years ago houses were generally finished with lime plaster, and these walls are today in an excellent state of preservation. Today gypsum has largely supplanted lime, without much evident effort having been made by the finishing lime producers to recover the business. A thorough chemical and physical study of the differences of the old lime putty and the putty made from the present hydrate, and a practical application of such knowledge would undoubtedly help to recover much of this business.

It has been our observation that there has not been a close enough relationship between the lime manufacturers and the possible users of the product. It is obvious that the technical staff of a lime plant should study industry in general to ascertain its needs and to introduce lime products into new fields. This has been done in other fields, to the mutual interest of both parties. An example of this is the use of high magnesium lime in the manufacture of glass. Years ago many glass manufacturers would not use a magnesium product. Many still refuse to use such a material, or will accept only a product containing a relatively small amount of magnesia. However, an intimate knowledge of both lines of business indicates the desirability of using the high magnesia lime product.

Until the lime manufacturer has a definite knowledge of the scientific principles underlying the manufacture of his product and the exact control of these principles in his plant operation, his general expansion will be greatly limited. A certain amount of scientific data is now available, but the majority of plant organizations are not prepared to avail themselves of this information, due to lack of personnel and equipment.

It is now definitely known that a lime product cannot be evaluated by chemical analysis alone. In most uses certain chemical classifications indicate the possible application, but the physical characteristics finally determine the value of the product for a particular use.

In some industries wastes have been developed into profitable byproducts, and this offers possibilities in the lime industry. The utilization of carbon dioxide in the manufacture of so-called carbon-dioxide ice has been much stressed and has resulted in premature speculation. However, with the patent situation being cleared up and improved apparatus, containers and ice boxes being developed, this particular phase of the industry merits careful watching.

Sand-Lime Brick Fares Much Better Than Competitive Clay Brick

EVIDENCE that a superior product will hold its own, even under such conditions as at present, even without anything like adequate promotional effort, is amply supplied by the recent history of the sand-lime brick industry. We have no failures to record. We find producers courageous and hopeful.

Production of sand-lime brick during 1931 dropped about 41% below the 1930 production. The shipments dropped only about 38% of the previous year's deliveries, indicating some depletion of stocked brick. These figures while bad enough, nevertheless show a healthier condition than in the clay brick industry, where shipments for 1931 show an estimated drop of about 72% compared to 1930.

The accompanying tabulation shows the

TABULATION BY MONTHS OF SAND-LIME BRICK PRODUCTION REPORTS FOR 1931‡

Month	Reporting plants	Production	Shipments—Rail	Shipments—Trucks	Stocks at end of month	Unfilled orders
January	21	3,718,025	910,377	3,366,634	11,593,938	5,245,000
February	21	4,139,670	1,492,938	3,306,038	12,544,898	6,720,000
March	24	4,868,840	1,466,348	3,742,653	12,566,492	7,070,000
April	20	3,999,410	1,697,882	3,330,089	11,118,716	5,232,000
May	23	5,084,457	1,594,890	4,374,806	10,724,004	6,513,000
June	20	6,663,656	494,350	5,757,820	8,974,809	9,960,000
July	21	5,518,386	528,980	5,423,821	10,199,107	10,710,000
August	22	5,989,061	805,000	5,505,524	10,697,804	10,838,000
September	20	6,943,080	871,500	4,922,014	10,865,677	11,532,000
October	20	6,520,594	977,000	4,657,294	12,346,671	11,437,000
November*	20	3,189,925	633,600	3,349,982	10,035,476	10,485,000
December†	....	3,000,000	600,000	3,000,000	10,000,000	6,000,000
Total	....	59,635,104	12,072,865	50,736,675	.....	.....
1930	....	100,677,687	35,430,380	67,118,449	.....	.....
1929	....	168,709,078	50,715,864	128,772,882	.....	.....

‡Represents roughly one-half the productive tonnage of the United States and Canada.
*Incomplete, one not reporting production and nine not reporting unfilled orders.
†Estimated.

production figures with other data on roughly 50% of the productive capacity of the sand-lime brick industry of the United States and Canada, based on reports made monthly by producers to Rock Products. The production for the month of December is estimated.

The accompanying table of clay brick production was compiled from the 1931 "Annual Supplement and Survey of Current Business," published by the United States Department of Commerce, and shows the shipments for the first eight months of the year for 30% of the total clay brick plants in the United States. The table shows the shipments of common clay brick for the years indicated:

1928	2,230,656,000 brick
1929	1,561,656,000 brick
1930	1,095,000,000 brick
1931	300,368,000 brick

The total shipments from the Department of Commerce figures for the first eight months of 1931 were 220,368,000; the total includes our estimate for the last four months of 1931.

Quoted prices of sand-lime brick in 1931 were slightly less than in 1930; but here and there were some evidence of price cutting. Wages and salaries were cut an average of 20%, with no immediate prospects of a quick return to normal wage levels. Labor conditions apparently are satisfactory to the employer. Plants employed 53% of the 1929 labor requirements.

Sand-lime brick plants were kept repaired and maintained as necessary, with no more work being done apparently than was absolutely necessary.

Photo by Manning Bros., Detroit

Clay brick in foreground badly corroded

New Plants

One new plant was built in Minneapolis, Minn., by the Zenith Construction Co. This plant uses the German Rohrig and Koenig system. A second plant was reported as being built in Los Angeles, Calif., by the Pacific Hardstone Brick Co.

New Products and Developments

The Sand Lime Products Co., Detroit, Mich., installed a block machine and is making a sand-lime block that has exceptional selling qualities and has met with an unusual demand.

The Wisconsin Brick Co., Madison, Wis., installed a dragline for securing its own sand requirements.

The Watertown Builders Supply Co., Boston, Mass., installed its third press during the year.

Sand Lime Brick for Sewer Construction

In Detroit, Mich., is an excellent example of unusual uses to which sand-lime brick has been put, with very successful results. This was a sewer job constructed in 1928. The construction of this open-cut sewer was of repeated sections of sand-lime brick, hard burned common clay and vitrified clay paving bricks. The sewer handles the discharge from Detroit's Oakwood pumping station on Baby Creek, about two million gallons per day. The two illustrations from photographs taken in 1931 show how well the sand-lime brick has stood up in comparison with the common clay brick, and indicates the adaptability of sand-lime brick for all classes of sewer work.

Photo by Manning Bros., Detroit

The sand-lime brick showed very little wear

Elected Vice-President of Gypsum, Lime and Alabastine, Ltd.

J. E. McCONNELL has been elected vice-president of Gypsum Lime & Alabastine, Canada, Ltd., succeeding the late O. R. Whitby. Mr. McConnell is president and general manager of McConnell and Ferguson, Ltd., and also a director of the Brantford Roofing Co. and the Northern Life Insurance Co.—*New York* (N. Y.) *Journal of Commerce.*

Talc and Soapstone Finding New Markets

By Oliver Bowles

ALTHOUGH talc and soapstone for the most part are applied to quite diverse uses, it has been customary to consider them under one heading. The only justifications for such combined treatment are that soapstone consists essentially of talc, and some waste material is sold in pulverized form for the same usage as low-grade talc. In view of the fact that 93 to 96% of all commercial talc is sold in pulverized form, whereas the quarrying and manufacture of soapstone are essentially parts of the dimension-stone industry, separate treatment is amply justified, and they are considered under separate headings herein.

Talc

Commercial talc is a hydrous magnesium silicate usually containing small quantities of impurities such as clay, iron oxide, silica, calcite and dolomite. The most characteristic physical properties are its softness and soapy feel. It resists and retains heat remarkably well and also is very resistant to the action of acids and alkalies. It has high dielectric strength and in finely ground form is colloidal. Talc deposits usually occur as irregular or lenticular bodies that have resulted from alteration of magnesian minerals such as amphiboles and pyroxenes.

The uses of talc are closely related to the characteristic properties. Its white color and colloidal nature adapt it for the manufacture of paper. The soapy feel and freedom from grit make it suitable for manufacture of talcum powder and other cosmetics. It is also used as a filler in paint, rubber and textiles; a constituent of ceramics and glass; an insecticide; an insulating material; in lubricants; and for foundry facings, roofing and coal-mine dusting. On account of its electrical resistance and property of hardening under heat treatment a pure massive type is used for so-called lava products such as electric insulators and gas tips, though the latter use has declined greatly; in addition it is used for making crayons, pencils and tailor's chalk.

Talc is mined chiefly in New York and Vermont, these two states producing 75% or more of the total production. New York, which supplies about one-half of the entire production, has two distinct types—the fibrous talc of the Gouverneur district and the non-fibrous type from Natural Bridge. Other producing states are California, Maryland, North Carolina and Georgia.

The table at the top of the next column was compiled from the U. S. Bureau of Mines figures and shows the marketed production of talc in the United States and its value over a period of several years.

MARKETED PRODUCTION OF TALC IN THE UNITED STATES (IN SHORT TONS)

Year	Quantity	Value
1924	178,191	$2,226,671
1925	188,835	2,144,017
1926	181,568	2,110,994
1927	192,316	2,234,724
1928	202,976	2,537,994
1929	219,144	2,617,756
1930	179,385	2,108,338

It will be observed that while the tonnage in 1930 declined 19% from the banner output of 1929, it was about the same as in 1924 and 1926. Prices were sustained remarkably well throughout 1930. Figures for 1931 are not available, but the continued business depression indicates further recession in sales. Price quotations in 1931 varied little from the level of 1930. While sales in 1931 have naturally decreased considerably, prices of talc apparently have been maintained better than those of most commodities.

The Canadian talc industry was seriously depressed early in 1931. For the first half of the year production was reduced 14% in quantity and 25% in value from figures for the first half of 1930.

Recently uses of talc have been extended into fields that promise consumption of increasing quantities. Various materials are finding use as admixtures in concrete, and claims for the advantages of talc include increased plasticity, increased resistance to water and acids, and greater strength. Use of talc as an ingredient of ceramic wares, notably glazed wall tile, is a noteworthy new development. According to report, quantities measured in carload lots are entering this field. It is claimed also that addition of talc greatly increases the life of saggers, the containers in which delicate ceramic wares are placed for firing; also talc is finding more extended use in glass-making.

The high tensile as well as high dielectric strength of pure calcined talc encourages its wider use for electrical insulation. Steatite (massive talc) is now used in England for the manufacture of high-tension insulators.

Increasing tonnages of talc are being used to dust coal mines to prevent coal-dust explosions. Low-grade impure talc may be employed for this purpose. Pulverized material is used as an insecticide, and while this is a small market it bears some promise of expansion. It is found to be useful principally as a coating material which kills plant- or fruit-destroying organisms by closing their pores. It also forms an adhesive coating that tends to keep insects away.

Soapstone

While the word "soapstone" was used originally as a synonym for massive talc it is now applied commercially to any talcose massive rock having a soapy feel. Some soapstones contain not more than 50%, and few of them more than 80% of talc. The remainder of the rock is made up of chlorite, amphibole, pyroxene and mica, with smaller quantities of pyrite, quartz, calcite or dolomite. Soapstone is therefore a rock rather than a mineral.

During recent years uses of soapstone have greatly multiplied. For many years laundry tubs and kitchen sinks contituted the major part of the business, but now it comprises only about 10% of the volume. Its resistance to acids adapts soapstone remarkably well for lining retorts in paper mills and for making laboratory-table tops, hoods, ovens and acid tanks. Because of its high dielectric strength it is employed for switchboards and other electrical uses. It greatest recent expansion is in the building trades. Soapstone is more and more widely used for sanitary partitions, shower compartments, sills, interior and exterior trim, wainscoting, spandrels, stair treads and floor tile. The two last-named uses demand the harder varieties. Ground soapstone is used in roofing manufacture, as an admixture in concrete, and for coal-mine dusting.

While soapstone has been produced in Maryland, North Carolina, Rhode Island and New Hampshire, the industry is now confined almost exclusively to the deposits at Schuyler, Va., operated by the Virginia Alberene Corp. The occurrences of this region consist of irregular or lenslike dikes bordered with schist and peridotite. They have probably originated as alteration products of basic igneous rocks. Many openings have been made on these dikes, new quarries being opened up as old ones are worked out, but reserves appear to be adequate for many years. Well-equipped sawing and finishing mills are operated at Schuyler to make a great variety of products. No market quotations for soapstone are available, as it is sold direct to consumers on contract.

As the building trades consume a major part of the output, the pronounced stagnation in building construction during the past two years has caused corresponding recession in sales of soapstone. As it is used more widely in office buildings and other large structures than in residential building, contracts for public works and privately owned buildings of large size in New York and other eastern cities have created a market of some magnitude, although sales are far below those of normal years. For further details on soapstone the reader is referred to a recent publication* and also to an article by the same author to appear soon in Rock Products.

*Hughes, H. Herbert, Soapstone: U. S. Bureau of Mines Information Circular 6563, 1931.

Developments in the Feldspar Industry

Granular Glasspar a New Product

By C. H. Peddrick, Jr.
Vice-President, United Feldspar Corp.,* New York City

DEVELOPMENT AND PROGRESS are necessary in any industry. Costs must be lowered, products must be improved and consumers must be satisfied, by virtue of lower costs for their raw materials, and by the availability of raw materials of improved quality and properties.

In the feldspar industry there have been three main developments. The first, which took place about 1916, was the replacement of the intermittent type batch milling by closed-circuit grinding with conical and tube mills. The second development in the industry occurred in 1927 when the Tennessee Mineral Products Corp. placed in operation its new plant under chemical control. The third outstanding development was the production of granular "Glasspar" also by the Tennessee Mineral Products Corp. in the fall of 1930.

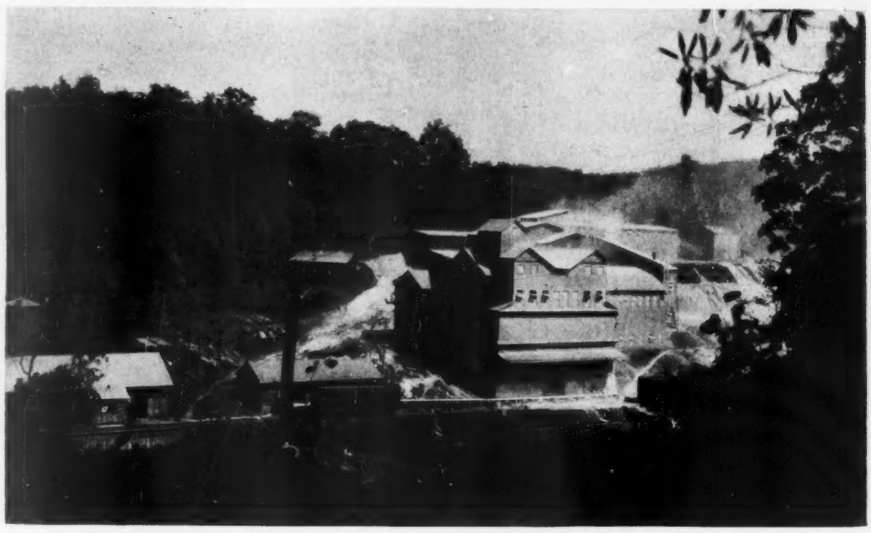
In order to realize why these are outstanding developments in the feldspar industry, one must appreciate that continuous grinding lowered costs by the replacement of the inefficient batch mill with the conical or tube mill in closed circuit with air classifiers and screens. The old batch mill was very costly in operation because of its high power consumption and high labor expense in loading and unloading. Continuous grinding, moreover, resulted in a more uniform grinding than was heretofore possible, as it was easier to control the sizing of this product by the use of classifiers with the grinding apparatus.

The adoption of chemical control to insure uniform products was another step forward in the industry. By segregation of the crude feldspars, accurate sampling and by determining the actual chemical composition of the crude spar prior to grinding, it has been possible to correct the variation in shipments which were made by producers operating without chemical control.

It can be readily appreciated that this move was of direct benefit to the consumer for it reduced not only the losses in ware due to variation in the feldspar purchased but it also allowed the meeting of difficult specifications by the producers.

The third and outstanding development in the feldspar industry was the production of granular glasspar in the fall of 1930 by the Tennessee Mineral Products Corp. This product is an improvement over the ordinary feldspar for its uniformly low iron content is due to special processing and equipment which removes practically all iron and iron-bearing impurities. Furthermore, it has the desired grain size for use in glass. Most glass manufacturers require a granular, free-flowing feldspar free from dust. This product, heretofore, was not obtainable as all grinding of feldspar has been carried on in pebble mills, a process resulting in the production of a large amount of extreme fines. These are undesirable for use in a glass batch where most of the other materials are of a granular nature.

*Controlling and operating the Tennessee Mineral Products Corp., Oxford Mining and Milling Co., United States Feldspar Corp.



General view of plant of Tennessee Mineral Products Corp.

Glassmakers who have used granular glasspar summarize its advantages as follows:

(1) Low and more uniform in iron content.
(2) Dustless in unloading, weighing and mixing.
(3) Flows more freely to batch mixer.
(4) Requires less heat, a quicker and more uniform melt.
(5) Prevents clogging of checkers.
(6) Enters the batch mix more evenly and perfectly.
(7) When used with other granular ingredients, lessens batch separation.

The processing of granular glasspar involves radical departure from the conventional grinding process. In this new process, crushing rolls are used instead of the pebble mills that feldspar grinders have employed to the exclusion of all other types of reducing equipment. Electric vibrating, double-deck screens are used in closed circuit with each set of rolls. The oversize is returned to the same rolls, the crushed material between the two decks of the screen pass to a second set of rolls while the undersize which is minus 20-mesh, after the removal of fine dust, is passed through the induction magnetic separator. This almost completely extracts from the feldspar contaminating minerals such as metallic iron, garnet, tourmaline, biotite and muscovite mica.

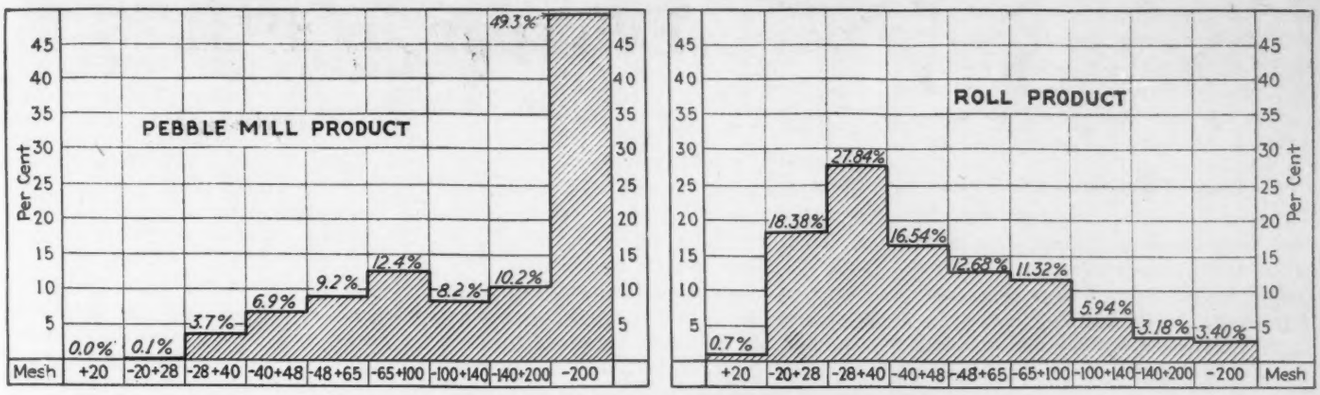
Screen tests showing pebble mill ground feldspar and feldspar produced by the new granular glasspar process are shown in the accompanying charts. The uniformity in particle size of the granular glasspar, as compared to the usual ground spar of the same mesh, is very evident.

The year 1931 has proven that granular glasspar is an outstanding development in the feldspar industry because production of this product has been maintained consistently at high levels in spite of the general drop in sales of feldspar. Furthermore, consumers of feldspar for use in glass have shown a continued preference for this grinding.

Demise of Feldspar Grinders' Institute

The early part of 1931 witnessed the cessation of activities of the Feldspar Grinders' Institute, due primarily to the lack of co-operation and interest by producers. This curtailment of activities is to be regretted for the Institute was helpful and of value, not only to the industry as a whole but to the consumers of feldspar as well.

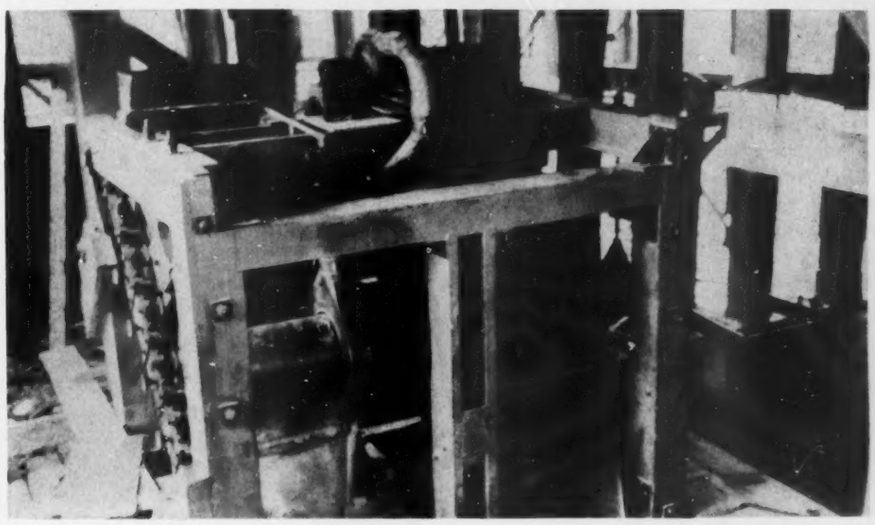
The Feldspar Grinders' Institute encouraged and fostered friendliness among its



Comparative screen tests of pebble mill and roll products

members, including the individuals who composed the personnel of these companies. The records which it maintained and the data which it furnished to its members were valuable as a guide to conditions in the industry. The Institute proved its value in many instances as it corrected bad practices in the industry.

Undoubtedly, the outstanding result of the Feldspar Grinders' Institute was its standardization of feldspar. This standardization of feldspar was important, because it placed the production and selling of feldspar on a sound, logical and scientific basis. There had long been a need for standardization of feldspars including grade, grinding and method of chemical analysis. Although the variety of analyses of feldspar available and the many grindings required are numerous, yet feldspar can now be purchased and sold based on standard specifications, approved and accepted not only by the United States Bureau of Standards but also by the majority of the producers, dealers and consumers of feldspar.



Magnetic separator used in removing iron from the product

Duty on Crude Spar Reduced

On April 23, 1931, an application was made by domestic grinders of Canadian spar for a reduction of 50% in the tariff on crude feldspar imported into this country. This investigation which was begun June 15, 1931, showed that in the principal mining regions of the United States, which are North Carolina and the New England states, companies operating both mines and mills obtain a large proportion of their supply of crude feldspar by buying directly from many small producers who, in 1930, produced 42% of the total domestic production. It was shown that in 1930 the quantity of crude feldspar produced in the United States declined 13% whereas, during the same interval, the imports of crude Canadian feldspars decreased 30%. The report of the Commission shows that the cost of Canadian feldspar exceeds the corresponding cost of domestic feldspar by $2.44 per ton at consuming points, after taking into consideration the difference in price between Canadian and domestic feldspar and making allowance for the possible effect upon cost of the depreciation in the Canadian dollar and that the maximum reduction in duty permitted by law, namely 50c. per ton, is warranted. This new rate was to go into effect January 2, 1932. The Tariff Commission, in its report, does not specify any change in the duty on ground feldspar, therefore the rate remains at 30% ad valorem.

In connection with the tariff, it is interesting to note that Canada is intent on being independent of America feldspar. The construction of a new mill at Buckingham, Quebec, will supply the Canadian consumption of this material. This mill, which is located convenient to mining centers, should

Another view at the plant showing the receiving bins

have many advantages over domestic mills which have been supplying Canadian consumers of feldspar. The imposition of a duty on ground American feldspar entering Canada has been instrumental in causing a decline in the exports of feldspar to Canada.

Domestic Competitive Conditions

The tariff situation was relatively unimportant as compared to the developments among the producers themselves. Continuation of intense competition has resulted in prices being lower than they have been in many years. Competition for business is so keen that in many instances consumers are being offered feldspar at prices lower than the actual cost of production. Productive facilities are more than three times present consumption and it is readily understandable why such keen competition exists. Price conditions in the industry are indeed far from satisfactory.

The year 1931 will be remembered as an eventful year by the feldspar producers. The development of granular glasspar and its wide acceptance by the glass industry was outstanding as it marked the development of a new improved product. The practical use of the new Standards and Classifications C. S. 23-30, showed conclusively its merits and value to the industry. The cessation of activities of the Feldspar Grinders' Institute due to lack of cooperation by producers was a distinct loss to the industry as a whole. At present, with price cutting so rampant, the Institute would be most helpful to its members in its endeavor to correct competitive abuses. The reduction of 50c. per ton on crude Canadian feldspar indicated that this product was not competitive with the domestic materials. Continued intense competition, principally in the form of price cutting, resulted in the lowest prices of feldspar in many years. It is quite apparent that promiscuous price cutting will continue for 1932 unless the producers respect costs rather than competition as the basis of selling prices. "There can be no progress without profit." Shall we see the light and turn toward it, in order that progressive development may continue in this basic industry?

Shales and Brick Clays of Georgia

THE geological survey of Georgia, under the direction of S. W. McCallie, state geologist, and assisted by Richard W. Smith, assistant state geologist, has issued Bulletin No. 45 on the shales and brick clays.

This report should be valuable to those interested in the mineral resources of the state of Georgia and in possible economic uses of some of these deposits, as well as the ceramic engineer or manufacturer. The 348-page book is well illustrated and is a valuable addition to the published information on the clay resources of that state. Copies may be obtained from the geological survey at Atlanta, Ga.

Feldspar in 1931

By Oliver Bowles

FELDSPAR is a general term for an important group of minerals consisting of several species, all of which are silicates of aluminum containing either potash, soda, or lime, or two or more of these bases. They fall in two main groups, the potash feldspars and lime-soda feldspars. Microcline and orthoclase are the chief members of the first group, while albite and oligoclase are the most important of the second or plagioclase group. Potash feldspars are the chief commercial varieties.

Feldspars are very common minerals in nature, forming a large part of such rocks as granites, but they cannot be profitably separated from ordinary granitic rock. The feldspars of commerce are obtained entirely from coarsely crystallized intrusive masses known as pegmatites which consist essentially of quartz and feldspar in large crystalline masses. The most important deposits are along the Atlantic seaboard, from Maine to North Carolina and in South Dakota, Colorado and California.

The chief use of feldspar, consuming about seven-eighths of the total, is as a fluxing agent in pottery, glass, enamel and other ceramic wares. In pottery manufacture it is used in both body and glaze. Another noteworthy use is for manufacture of scouring soaps and window-cleaning compounds, for which application the quartz content must be low. It is used as a binder for abrasive wheels; also for poultry grit, roofing, stucco and foundry facings. A beautiful green variety of microcline known as Amazonstone is produced for decorative purposes at Amelia Court House, Va.

As the chief consumption of feldspar is in the pottery trades, the principal marketing centers are Trenton, N. J., and in the vicinity of Sebring, Ohio, though substantial quantities are sold in other markets. Part of it is shipped in ground form and part as lump spar to be ground near points of consumption.

The feldspar industry is passing through a rather difficult period. Production of crude spar in 1930 was 171,788 long tons, which was nearly 26,000 tons less than in 1929. Stagnation in sales has continued during 1931, and while no figures are available for that year it is probable that sales will be even lower than in 1930. Not only is the tonnage decreasing, but the price per ton shows steady decline since 1926. If Canadian figures are any criterion of conditions, the picture is not bright, for production in Canada decreased 21% in quantity and 23% in value during the first half of 1931 as compared with the first half of 1930. Canadian exports were depressed even more greatly, for they fell from 12,170 to 4,150 tons in the corresponding periods mentioned above. The duty on crude spar coming into the United States, which became effective in June, 1930, no doubt accounts for a substantial part of the decrease, because the United States is Canada's chief market. The following table prepared by the United States Bureau of Mines shows sales of crude spar for a series of years:

CRUDE FELDSPAR SOLD OR USED BY PRODUCERS IN THE UNITED STATES, 1921-1930

Year	Long tons	Value	
		Total	Average
1921	91,865	$617,652	$6.72
1922	117,127	844,568	7.21
1923	145,004	1,057,595	7.29
1924	204,772	1,509,339	7.37
1925	185,706	1,315,654	7.08
1926	209,989	1,607,101	7.65
1927	202,497	1,424,755	7.04
1928	210,811	1,418,975	6.73
1929	197,699	1,276,640	6.46
1930	171,788	1,066,636	6.21

About 60% of the total production of crude spar is obtained in North Carolina, the amount from this state being nearly five times that from Maine, the second largest producer; New Hampshire ranks third. A very large percentage of all spar marketed is used in finely ground form. In 1930, 34 feldspar grinding mills were in operation in 12 states.

Developments During Year

A few recent changes in ownership and plant activity are to be noted. According to report, the plant at Keystone, S. D., was a very active producer during 1931. The Western Feldspar Milling Co. of Denver, Colo., was planning early in 1931 to erect a new feldspar grinding mill at Canon City, Colo. Nevada has for the first time become a producer. It was reported in August, 1931, that three carloads had been shipped to Berkeley, Calif., from a newly developed deposit at Peavine Siding, 18 miles north of Reno, Nev. The Consolidated Feldspar Corp. of Trenton, N. J., has purchased the business of the Flynt and Spar Co. of Los Angeles, Calif., and plans to erect a grinding mill at Kingman, Ariz.

The tariff act of 1930 levied a duty of $1 a ton on crude feldspar imported into the United States, and 30% *ad valorem* on ground feldspar imported. As crude spar has heretofore been on the free list, the duty imposed has an important effect on foreign trade, particularly on that with Canada, which is the chief foreign source of supply. Some American grinding plants are supplied exclusively with Canadian spar and in response to an application for a decrease in the duty of $1 a long ton on crude spar the United States Tariff Commission instituted a cost of production investigation. Upon recommendation from the commission the President reduced the rate, effective as of January 1, 1932, to 50 c. a ton, the maximum reduction allowable under the so-called flexi-

ble provisions of the tariff act. The rate on ground spar is unchanged.

Excessive milling capacity is a serious condition facing the industry. It is estimated that feldspar grinding mills in the United States have an aggregate capacity of 500,000 tons or more a year, or nearly three times present market demands. This condition suggests the need of unusual caution in any further expansion of milling capacity.

An important step in progress in 1931 was acceptance by the grinders of a trade-practice code, according to which they agreed to sell no goods below cost, make no discrimination in prices, allow no secret rebates, refunds or unearned discounts and make no misrepresentations as to quality, quantity or origin of goods.

Progress in Standardization

Within the past two years the feldspar industry has made notable progress in classification and standardization. Producers and consumers in cooperation with the U. S. Bureau of Standards perfected a new scheme of classification which has been published by that bureau as Commercial Standard CS 23-30. The classes are based on fineness of grain determined by sieve tests, and on silica and soda content and potash-soda ratio for pottery feldspars, while for use in the glass industry spar is classed according to grain size and on the basis of the silica, alumina and iron content. This classification was made effective for new production September 1, 1930, and absence of any evidence of dissatisfaction during the following year indicates that it is meeting with general approval.

The scheme of classification now in use necessitates more thorough knowledge of the chemical and physical properties of feldspars than has been found necessary heretofore, and this demand has stimulated extensive testing and research. A wide field exists for such experimentation and study because the variable nature of the material, together with numerous impurities that may be present, greatly complicate efforts that may be directed toward the preparation of supplies having constant and dependable qualities.

Many articles have recently appeared in the technical press dealing with the mineralogy of feldspars, their chemical and physical properties and their behavior in use. The most notable recent advance in feldspar milling is the use of electromagnetic induction separators to prepare a pure granular spar specially suited for the glass industry. Ordinary impurities such as garnet, pyrite, tourmaline, hematite and biotite are removed. Some work has been done on devising a flotation process which will separate quartz and feldspar, but no conclusive results have been attained. Much interest is shown in technical progress, but no marked increase in sales is to be expected until general recovery of business occurs.

Slate Producers Reduce Costs as Well as Prices

By Oliver Bowles

MORE THAN 80% of all slate sold in block or slab form is used in building trades either as roofing, structural and sanitary slabs, or blackboards. In addition to the above, a large part of the electrical slate and of that sold as floors, walks and terraces is directly related to building construction. It is apparent, therefore, that conditions in the slate industry tend to reflect to a marked degree the volume of building throughout the country. The serious depression in building during the past two years has, indeed, partially paralyzed the slate industry in most producing centers. The manufacture of granules has also fallen off greatly. Both granules and roofing slate find some support in reroofing projects which continue in some volume even when new construction lags. Quite a number of quarries and mills are temporarily closed, and those in operation work on a part-time basis in practically all districts. Results of a survey of large cities, which recently appeared in press reports, indicating that the percentage of vacant houses is abnormally low presents one bright spot in the picture, for it reveals an accumulating housing shortage that must soon be met by more active building.

Sales of slate during 1930, according to the U. S. Bureau of Mines, were valued at only $7,915,105, as compared with $11,245,178 in 1929, a decrease of about 29%. The volume of slate sold decreased about 31%, which indicates that the average unit price received was slightly higher in 1930 than in 1929. Production figures for 1931 are not yet available, but preliminary data from a number of representative companies indicate that 1931 sales have been considerably lower than those of 1930. Prices quoted in the press during 1931 were a little lower than in 1930. Comparative figures for 1929 and 1930 by uses are shown in the accompanying table which was compiled by the U. S. Bureau of Mines.

In July, 1931, the U. S. Bureau of the Census issued a press release showing some very interesting comparisons between the slate industry of 1929 and that of 1919. During the 10-year period the volume of slate sold increased 66.7%, whereas the value of the product increased 83.3%.

Trends in 1931

No developments of unusual interest are to be noted for 1931, but certain trends have become more pronounced. The industry is confronted with difficult marketing problems because of the competition it must meet in practically every line of production. For every use of slate some other material may be substituted. This keen competition has led the industry to undertake two definite lines of inquiry to improve its position. The first has to do with improving quarrying and milling conditions and reducing waste to such an extent that production costs are reduced, and the industry is thereby in a position to face price competition on a better basis. Wire saws reduce both cost of cutting and proportion of waste in quarries. Milling methods have likewise been improved by the use of better saws and by the introduction of drum sanders and sand recovery equipment. Some thought is being given to the use of wire saws in mills.

Quality Improved

The second line of inquiry has as its object improvement in the quality of products sold, for the industry realizes that satisfaction to customers is the most effective advertising. To this end much study has been devoted to the properties of slate in their relation to use. The National Slate Association and Committee D-16 of the American Society for Testing Materials are sponsoring better classification and more adequate specifications. The United States Bureau of Standards, Lafayette College, Lehigh University, Rensselaer Polytechnic Institute and Pennsylvania State College are collaborat-

SLATE SOLD BY PRODUCERS IN THE UNITED STATES, 1929 AND 1930, BY USES

Use	Quantity—1929	Value	Quantity—1930	Value
Roofing ..... squares	462,120	$4,920,766	340,140	$3,363,426
Approximate equivalent in short tons	178,500	.....	127,080	.....
Electrical ..... square feet	1,461,110	1,153,396	923,760	717,573
Approximate equivalent in short tons	12,580	.....	7,690	.....
Structural and sanitary ..... square feet	3,286,550	1,287,150	2,498,340	960,190
Approximate equivalent in short tons	24,730	.....	19,190	.....
Grave vaults and covers ..... square feet	515,450	133,031	350,440	85,047
Approximate equivalent in short tons	4,700	.....	3,290	.....
Blackboards and bulletin boards ..... square feet	3,562,360	1,042,771	3,092,880	921,735
Approximate equivalent in short tons	9,280	.....	7,830	.....
Billiard-table tops ..... square feet	161,470	65,426	143,440	57,750
Approximate equivalent in short tons	1,390	.....	1,270	.....
School slates ..... pieces	1,843,000	20,371	1,688,540	19,230
Approximate equivalent in square feet	949,540	.....	903,360	.....
Approximate equivalent in short tons	1,030	.....	850	.....
Flagstones, walk ways, etc. ..... square feet	1,248,190	124,524	895,230	100,732
Approximate equivalent in short tons	8,920	.....	6,710	.....
Granules and "flour" ..... short tons	428,940	2,497,743	289,700	1,695,417
Total (quantities approximate, in short tons)	670,070	$11,245,178	463,610	$7,915,105

Keystone View Co. Inc. of N. Y.

Waste in slate quarrying is still a big problem, which, however, the developing market for irregular slabs for landscaping is helping to solve

ing in exhaustive studies of properties and methods of tests. Prof. C. H. Behre of Northwestern University has been accumulating interesting data on the acid and alkali resistance of slate. It is hoped that information obtained in these various ways will enable slate producers to classify their materials more intelligently and to direct each type to the use for which it is best adapted.

Efforts are being made also to widen the market area in which slate may be sold profitably. Owing to recent reductions in rail-water rates, increasing quantities of slate are reaching Pacific Coast points by way of the Panama Canal.

The Federal Specifications Board for three years has devoted much study in an effort to formulate a roofing slate specification for government use. Tests have been developed which it is believed will sufficiently indicate enduring qualities to permit definite and reliable classification into three main groups. Conferences have been held, and criticisms from the industry have been invited, for the purpose is to establish means of securing dependable slate of any desired quality with a minimum of inconvenience or hardship to producers.

Of the more recent developments mention should be made of the rapidly increasing market for irregular pieces of slate such as mill ends and waste used for garden walks, terraces and copings and in masonry walls.

The various efforts toward stabilizing and improving the slate industry as recounted in this review are showing little immediate benefit because their effects are overshadowed by the general recession in sales owing to business depression. These movements are, however, laying a foundation for improved technique, better products and a sounder basis of competition that will, it is believed, bear fruit when normal conditions reappear. The most important problems facing the industry relate to sales. A definite movement is on foot to establish larger and fewer marketing agencies in Vermont, Maine and Pennsylvania.

To Rebuild Mica Plant

THE Western Mineral Products Co. has decided to rebuild the mica plant, near Guernsey, Neb., which was destroyed by fire some time ago. Jack Berry, superintendent of the mine, has arrived in Guernsey with the information that work of rebuilding is soon to be started and that the new mill will be twice the size of the old one, with the capacity many times enlarged. A conference with the officers of the Muscovite Milling Co. of Salt Lake City has been arranged for December 15, when further plans for development are expected to be made.—*Scottsbluff* (Neb.) *Herald.*

Asbestos in 1930

DOMESTIC and Canadian producers of asbestos during 1931 were reported to have been adversely affected from two sources: (1) the loss in volume and value per ton due to the world's economic condition, and (2) by the activities of foreign producers.

The United States Tariff Commission is investigating the sales and importations from foreign sources as a result of recent charges of unfair practices made by two United States asbestos fabricators.

Production of domestic crysotile asbestos in 1931 increased, but prices declined somewhat, indicating that with a few normal years the domestic industry may yet grow to a position of importance.

Gypsum Plant Burns

THE GYPSUM PLANT of the Certain-teed Products Co. at Laramie, Wyo., was destroyed by fire December 28. This plant had been idle since July, 1930, and there was no watchman stationed there, according to reports. It is estimated that the plant was worth about $100,000. Origin of fire is unknown.

Keystone View Co. Inc. of N. Y.

Hoisting an extra large piece of slate to the surface 300 feet above

Phosphate Rock Industry Suffers from Ill-Conceived Propaganda

Agriculture's Dire Need of Phosphoric Fertilizer Beclouded by Emphasis on So-called High Analysis Fertilizers Containing Relatively Small Amounts of Phosphorus

By H. D. Ruhm

Vice-President, Ruhm Phosphate and Chemical Co., Chicago, Ill.

IF OTHER EVIDENCE were wanting of the position of enormous importance occupied in the economic life of the world by phosphate rock and its products, little doubt of that fact will remain when it is noted with what sensitiveness and rapidity the phosphate rock industry reflects conditions of great adversity and depression such as the world in general and the United States in particular suffered during the past two years, culminating as we fondly trust with the end of 1931.

It is of course impossible as yet to give definitely the United States production or shipment of this product for 1931, but enough is known to justify the expectation that the figures when finally compiled will be found to have fallen short of the tonnage of 1930 by fully 30%.

Our estimate made last year of a 20% reduction from the 1929 figures proved erroneous, according to the United States Export Association figures, which show the total having slightly increased over 1929.

Export shipments were slightly increased in 1930 over 1929, as well as those to the domestic market.

Naturally a large part of 1930 shipments were for anticipated consumption in the fertilizer trade of 1931 and as farmer consumption of fertilizer was much lessened in 1931 as well as 1930 much of the 1929 and 1930 shipment went toward greatly curtailing purchases during 1931.

The consumption of phosphate rock by the fertilizer trade has, in the writer's opinion, based on talks with close observers of the industry both within and outside of the ranks of actual manufacturers, been greatly curtailed by the tendency of the trade to push more and more the use of what is known as high analysis fertilizers, with a smaller content of phosphoric acid compared to other ingredients.

The enormous increase of propaganda agencies of every sort for pushing the sale of fertilizers containing far greater quantities of nitrogen and potash than ever before included in mixtures has caused a decided drop in the proportionate percentage of phosphoric acid contained in the average grades sold, so that even an equal tonnage of complete fertilizers would mean a considerable reduction in units of phosphoric acid used and *a fortiori* in tons of phosphate rock utilized for manufacturing these fertilizers.

Phosphoric Acid the Greatest Need

By far the greatest development of the fertilizer industry of the United States has been in the southeastern section, where fertilizers for cotton form by far the largest part of the business, indeed so much so that even now much the larger part of the entire United States production of fertilizer is used under cotton.

The major development of the industry came during and at the culmination of the period of time in which by far the greatest tonnage consumption was the old time 2-8-2 fertilizer containing 2% of nitrogen, 8% available phosphoric acid and 2% potash.

During most of that time lower grade phosphate rock was used and 16% superphosphate was about the best grade produced, much of it only running 14%, so that even to get in the 2% each of nitrogen and potash from many of the organic products used, not a great amount of filler had to be used. For instance, 1143 lb. 14% super, 571 lb. 7% tankage or cotton seed meal and 286 lb. of 14% Kainit made a ton of 2-8-2 with no filler at all.

As higher grade rock and better methods of acidulating and consequent higher grade superphosphates became common, more and more filler had to be used to cut down to the 2-8-2 standard, and higher analysis fertilizers being more easily produced, great stress was laid on the desirability of increasing grades to 2-10-2, 2-12-2 and 4-12-4, 4-16-4 and so on.

Here was a good move for all concerned. The farmer would get more units of plant food in the same number of tons and at lower unit cost and longer hauls of fertilizer be thus rendered possible, extending the areas to which factories could ship. Larger tonnages of superphosphate, the only product actually manufactured by the then existing industry could be used, and greater consumption of phosphate rock could be developed.

During this era all the big fertilizer companies possessed themselves of enormous holdings of phosphate rock, forming a large part of the basis for their largely increased capital structure.

The number of agronomists conducting experiment station trials of various fertilizers and leading the trend of thought as to proper ratios of various plant foods for manufacturers to produce, who are not particularly conversant with or interested in or engaged in trials for production of cotton, is far more than inversely proportional to the importance of cotton to the fertilizer industry.

The net result of this situation, coupled with the enormous activities of foreign and domestic producers of potash and nitrogen, has resulted in actual reduction of phosphoric acid consumption by excessive increase of nitrogen and potash in the ratios in the high analysis materials now in vogue.

Thus has the industry as previously constituted met the Waterloo of the past few years, and the true situation reflected by the stock market quotations of practically all fertilizer stocks is really due to phosphoric acid having been made less fashionable, to make room for the more attractive debutantes of nitrogen and potash in ever increasing ratio, while the old-time rock of salvation has become so slightly esteemed that little money has been made from its products.

With this picture in the fertilizer industry, which consumes over 75% of rock production, augmented by the lamentable inability of most farmers to buy any fertilizer at all, much less to buy more of the fashionable high analysis material, with the depressed condition of the baking powder industry, food phosphate, flour and other large consuming industries, requiring phosphoric

THE 1929 AND 1930 COMPARATIVE PHOSPHATE ROCK SHIPMENTS FOLLOW* (SHORT TONS)

	Total	Total domestic	Total export	Total Tennessee	Total Western States	Total Florida
1929	3,788,011	2,661,728	1,126,283	.....	.....	3,115,454
1930	3,937,020	2,719,278	1,217,742	570,074	75,500	3,291,446

Florida shipments, 2,073,704 tons was domestic and 1,217,742 tons export.

*Data supplied by Phosphate Export Association.

acid and other phosphorous chemicals, the iron and steel industry consuming both ferro-phosphorus and phosphate rock, the livestock feed industry and the inability of many of the farmers *willing* to use the finely ground phosphate rock or lime phosphate for direct application to the soil to purchase anything at all during the crisis now upon them, it is not to be wondered at that such drastic conditions have existed in the phosphate rock industry during 1931 as to cause a 30% reduction of 1930 tonnage; but rather it is a wonder that the industry has done even that well under the conditions existing.

Added to the reduction of tonnage both for export and domestic business known to have taken place in 1931 comes great loss from the recent drop in the pound sterling following English abandonment of the gold standard, as many export contracts call for payment in sterling over several years. Thus not only for 1931, but business for the future will be badly affected by continued depreciation of British exchange.

Importance of Merchandising

Much has been said publicly, and far more in private, about the extent to which the fertilizer industry during its great period of growth has fallen short of being in actuality a chemical industry, to which in name and popular thought it has laid such great claims, whereas of necessity it has been largely if not almost entirely a purely merchandising agency for materials known principally by practical trials to have decidedly beneficial effects on plant growth, mechanically mixed with superphosphate, the one and only article of actual chemical manufacture.

For by far the larger part of the industry, even this one process of manufacture, was confined to mixing or adding to each other, the two raw materials, sulphuric acid and phosphate rock, making two tons of so-called superphosphate from one ton of rock, thus securing the greater efficiency and increased rapidity of action of the desired phosphoric acid at the expense of a 50% reduction of the amount contained per ton of the finished product.

This naturally attracted the attention of the manufacturing chemist and chemical engineer, whose aim in most processes is of course the extraction of the valuable ingredient sought, and its reduction to the nearest possible degree of concentration to chemical purity.

The result has been a greater and greater trend toward accomplishment of this concentration, to which the industry has largely been forced by its own desire to really be what in name was accorded it, a chemical industry.

Much of the harm from this trend has been caused by the general acceptance of the theory that the only real values of fertilizers are their contents of nitrogen, water- and citrate-soluble phosphoric acid and water-soluble potash. The general result of this theory has been to write into the fertilizer laws of almost every state in the Union a general regulation that no values can attach to any fertilizer in the eyes of the control forces of the state, except such value as may be accorded to those three elements alone.

Naturally this put all the chemists who were working toward the high analysis idea to searching for means of producing for the market such fertilizer as should contain the nearest possible concentration to the three elements for which alone value could be claimed under the laws created by and with the aid and influence of the leaders of the industry itself.

As a matter of fact the action thus taken was in reality a confession of ignorance and existing inability to impart either to salesmen of the industry or its farmer customers the intricate chemical effects of all the constituents going to make up the real fertilizing values of the particular mixtures the industry was selling.

Preying upon such ignorance and inability it was easy for the charlatan to sell certain brands of fertilizer with widely heralded claims for potency, which could not be denied until after the deluded customer failed to get results, or claims which could not be checked by ordinary methods of analysis within the limits of cost of inspection and control.

Thus much real worth of many common brands of fertilizers being sold and profitably used was impossible of being translated into control agency valuations and was gradually lost sight of by the industry itself.

The widespread, absolutely necessary difference between the manufacturing cost, including a bare manufacturing profit and the price which ultimate consumers must pay, has ever been a stumbling block in the eyes of the farmer consumer, notwithstanding the incontrovertible evidence he has had before his very eyes for over 50 years that every dollar he has invested in fertilizers as a whole has returned to him a profit of over $3 in the average crop increases secured, at normal prices for farm commodities.

The chemists have contributed to this dissatisfaction to a large extent by basing many of their calculations of their exploited ideas of marvelous savings to the farmer, on the difference between manufacturing cost of the three bare elements of accepted fertility value, by their newly devised processes, and the prices commonly allowed for these elements by control agency valuation, which should at least contain sufficient margin to actually get the materials on the farmer's field with intervening profit to necessary sales agencies.

The cooperative idea, most excellent in itself from many aspects, has seized on this feature in every possible way, short-sightedly magnifying its importance to the exclusion of the far greater importance of conveying to the farmers full and complete information as to the proper use of proper fertilizers in the proper places and on proper soils for proper crops.

With all these factors beclouding the issue we are confronted with the situation that while only a comparatively few farmers use a comparatively small acount of fertilizer, many of them improperly and with not only no results but often even with negative results, yet the aggregate of farmers are still showing a general average of large profits from the average use.

How great would be the contrast to this situation, if the attention of chemists could be more largely turned to ascertainment of the real cause of benefits indicated by proper use of certain materials and consequently causing proper evaluation to be placed on the particular ingredients and qualities of these materials constituting such causes.

Values in Simple Materials

As a magnified example of contrasting conditions which can exist we are treated to a particularly impressive case in point with a material not generally classed in the category of fertilizer industry materials, but vastly important to that industry.

Reports of the Illinois Experiment Station show many results of application of limestone, certainly not in too small amounts per acre, where the increases of crops secured by such applications at normal prices have given a value to the limestone used of from $10 to $25 per ton. Yet this material sells in that state at about $2 per ton and a proposed increase of 15 c. per ton on the part of certain producers and agreed to by control agencies has brought a storm of protest largely and unwisely furthered by cooperative influence, contributing materially to the considerably over 40% reduction of Illinois use of agricultural limestone, even though the price was finally actually lowered instead of carrying the 15 c. increase!

Likewise many instances exist of proper use of finely ground phosphate rock or lime phosphate showing a value to the farmer, measured in crop increases produced by its direct application, of from $100 to $300 per ton of phosphate.

Yet we see practically a buyers' strike against the prices of from $12 to $27 per ton at which this product reaches the farmer, according to quality, seller and locality of consumption.

We have definite authority for knowing that plant growth in general requires some 18 chemical elements, but most of these are thought to be contained in most soils, and by general consent calcium and the three previously stated elements have, as before mentioned, come to be considered the only four necessary to be added in artificial fertilizers.

Now when the Indian buried the fish with the grain of corn in Rhode Island and produced marvelous results where little or none was had without, it is a certainty that the benefit was by no means confined to the nitrogen, phosphoric acid and potash, or even to these three and the calcium contained.

When the ordinary farmer spreads com-

mon stable manure on his soil, the benefit secured cannot be duplicated by adding instead an equivalent quantity of calcium, nitrogen, phosphoric acid and potash shown by the analysis of the manure.

When the old style cotton farmer produces 200 or 300 lb. of lint cotton by dropping a little old-fashioned 2-8-2 fertilizer, or 150 to 200 lb. by dropping 14% or 16% acid phosphate under each row, from an acre of ground that without this treatment will produce from nothing at all to 75 or 100 lb., we know that this cannot be duplicated by adding the equivalent amount of calcium and phosphoric acid or the added nitrogen and potash contained on the one hand by the acid phosphate and on the other by the 2-8-2.

When on securing a complete analysis we find that the rock phosphate used actually contains 17 of the 18 elements referred to, minute though the content of many of them may be, and when we realize that the acid or superphosphate contains all of these elements originally in the rock, cut in half it is true, but some of them rendered far more soluble and at least one of them, sulphur, supplied in far greater amount than in the rock, and when we realize that the carriers of nitrogen and potash generally added many elements other than the actual nitrogen and potash on which values were allowed, we can easily see how in the flare for high analysis and concentrated chemical production of NPK the fertilizer industry may have lost more than it has gained either for itself or for its customers.

Certainly the phosphate rock industry has been a heavy loser of tonnage as a result.

While the immediate depression would cause a large part of this reduction of consumption of this material anyway, the effect of the factors above outlined makes it all the worse in this critical time and forces the consideration not only by independent miners, but by large fertilizer manufacturing owners and miners of phosphate rock deposits, of the problem as to what is to be done to increase the consumption of this all important material to take care at least of the existing productive capacity, only a small percentage of which is now in actual operation.

The One Big Opportunity

Here we are forced to dwell on the anomalous condition of 120,000,000 acres of cultivated land in the central and middle western states, the great majority of which is deficient in phosphorus, which uses a comparatively small amount of commercial fertilizer and which is gradually descending in productive scale, largely because of failure to restore the phosphorus depleted by many years of rather abundant but not by any means maximum crops.

If the entire present phosphate rock production of the Tennessee field were devoted to this purpose in the direct application of finely ground phosphate rock or lime phosphate to the soil in those states, it would furnish less than 18 lb. per acre, whereas practically every one of those acres has had removed from it by cropping more phosphorus than is contained in 6000 lb. of lime phosphate. High time to return some of it!

The unfortunate situation that has existed for so many years whereby the powerful fertilizer industry has worked so hard to prevent any use at all of phosphate rock alone and almost as hard to prevent even the use of superphosphate, unless mixed with nitrogen and potash, has borne the fruit that might have been expected, in that a minimum of all fertilizer has been used.

Clearer thinking along these lines has also been prevented to a great extent by the unwise assertions and insistences of some advocates of the unacidulated material that complete mixtures at high prices should be done away with, based on overburdening costs to the farmer and so on *"ad infinitum"*; the resulting controversy causing a more or less mutual blinding of both sides to the actual fact that no fertilizer sold to the farmers of this country for many years has been too high measured by what he could secure from its proper use and the only fertilizer that is too costly for him is that which he needs and does not buy.

A very few have seen from the outset that there is an easily obtainable market in the United States for three times the present consumption of complete goods for proper and highly profitable use and that side by side with that market is one for 100 times as much finely ground rock phosphate or lime phosphate as has been sold in the largest year of its history, which market will not use complete goods in any nearby time.

That such farmers who form the great potential market for this unacidulated product are the farmers most affected by the present low prices for farm products is no inconsiderable feature of interest in this matter.

The literature of agronomical research is filled with reports of experiments comparing or attempting to compare the efficiency or availability of phosphoric acid in the several carriers in which it is sold under various conditions.

It is undoubtedly true that the great preponderance of these experiments show in favor of acid or superphosphate over rock phosphate.

Results with Rock Phosphate

However, during the past 37 years more and more farmers have found, by practical use, great profits from the use of even the old low grade coarsely ground phosphate and far more from the use of the finely ground rock or lime phosphate, even at enormously higher prices necessitated for its proper preparation and distribution.

A large majority of these farmers finding such successful results have been located in Illinois where for a number of years the product had the whole souled endorsement of the experiment station, and so the decreased sales resistance was reflected in larger tonnage.

However, some farmers in every state included in the territory above referred to have had these good results on almost every conceivable soil type, although not any of them have had uniformly good results from every method of application and every degree or lack of other necessary soil amendments or accompanying fertilizer elements.

However, where a farmer is so located and his other activities are such as to give him profitable results from its use he is certainly entitled to purchase his phosphorus needs in the cheapest form per unit of effective phosphorus for his conditions.

If two great agencies attempting to benefit agriculture, on the one hand actual sellers of fertilizing materials for profit and on the other hand agricultural leaders advising farmers as to proper considerations in purchasing, should unite in seeking the places, the means, the methods and the correct surroundings making for the greatest possible profitable consumption of all fertilizer materials, instead of the shortsighted selfishness of different factions on the selling side bringing all possible influence to bear to bolster each its own product at the expense of all others, there could quickly be created a demand that would bring about the consummation before referred to; all sources of supply would then be on their mettle to furnish this demand instead of being engaged in the bickerings and uncertainties that now help to keep most farmers still unprofitably producing their products when world market conditions force low prices, and which at the same time cause the over-produced and depressed condition of the industries who are the suppliers of "nature's gold," the chief elements of fertility, notably phosphate rock.

More and more consideration is being given to this "way out" for the phosphate rock industry and in another article for later publication will be given some items of interest pointing to the development of this clearer picture of the true situation with regard to the fertilizing and feeding value of finely ground rock or lime phosphate.

A study of the literature on the subject has really been difficult owing to lack of any complete bibliography and to the very little complete knowledge possessed by many of all features involved in many of the experiments well known and widely used by one or the other side in the controversy referred to.

One of the important developments of the past year has been the preparation of a bibliography and digest of some 18,000 references to the literature on phosphorus experiments, with a digest of each annotated by competent agronomists.

This work has been carried on under Prof. Emil Truog at the University of Wisconsin under a fellowship supported by the Superphosphate Institute, and will shortly be published in attractive book form. This will be kept up to date with a reference to and digest of every publication on the subject.

This work will enable the future student of the question to quickly locate the salient literature bearing on the subject and by really finding out what has actually been done by experimental agencies in this line, be better able to plan work under his own conditions.

The writer has been privileged to examine the reference cards and has been astounded to find how many reports there are, hitherto unknown to him, of favorable results from use of rock phosphate, and how much chance there appears to be of applying these results to wider and wider areas if proper conditions are brought about.

Use for Animal Feed

The feeding experiment at Wisconsin (supported by the Ruhm Phosphate and Chemical Co.) under direction of Dr. Bohstedt, of the Animal Husbandry Department; Dr. E. B. Hart, of the Agricultural Chemistry Department, and J. G. Halpin, of the Poultry Husbandry Department, by A. R. Lamb and P. H. Phillips, planned to determine the proper safe and beneficial levels at which finely ground lime phosphate can be fed to swine, beef and dairy cattle and poultry, is proceeding well into the fourth year.

The forthcoming annual report of the director of the Wisconsin Experiment Station will cover nearly the first three years of this work showing safe levels of rock phosphate of the grade called lime phosphate to be for dairy cattle 5/8% of the grain mixture, and for poultry 1% of total ration. Dr. Bohstedt makes the general statement that: "Substituting one-fourth of the steam bone meal in minerals or mineral mixtures where these are required has from our results so far been entirely safe."

It appears that the experiment may finally show that 25% substitution of a proper quality of lime phosphate for bone products is without injurious effect, if not actually superior to straight bone, probably due to beneficial effects of a small amount of fluorine, which at larger levels is injurious, but a still higher level may be found to be entirely safe.

Improper quality of phosphate rock or the use of it in too large amounts is unquestionably damaging on account of the fluorine content of all phosphate rock and phosphatic limestones so far developed in this country.

Manuscript for publication has been prepared and is expected to be made at an early date in *Poultry Science* of the conclusions so far reached by these authorities at Wisconsin as to effect on poultry. Details of this cannot, of course, be given prior to publication, but they will prove of undoubted value both to the poultry and feed industries.

Dr. R. M. Bethke and Dr. C. H. Kick of the Animal Nutrition Department at the Ohio Agricultural Experiment Station have been carrying on similar work at Wooster and have secured corroborating results with swine, partial report on which has been made public and the final results of which will be shortly forthcoming. In letters to the writer of recent date the following statement has been made by Dr. R. M. Bethke, Nutrition Investigations, Ohio Agricultural Experiment Station, Wooster, Ohio:

"Concerning the status of our work with lime phosphate as a mineral supplement for swine, lime phosphate does not prove to be an efficient source of calcium and phosphorus when fed as high as 2% of the total ration.

"Recently we concluded trials in which were fed approximately ¼ to ½% of lime phosphate in comparison with the same quantity of phosphorus furnished by steamed bone meal. I am of the opinion that there will be little if any significant difference between the groups that received ¼ or ½% of lime phosphate, or the same amount of phosphorus, in the form of steamed bone meal. From the experimental work that we have completed I am rather confident that a limited amount of lime phosphate can be safely and economically fed to growing and fattening swine."

Mineral feeds are more and more necessary and beneficial as the knowledge increases of the proper mineral requirements of all animals and especially as more high grade livestock and poultry is produced for meat as well as for dairy products and eggs, and the insurance of a proper and economical supplement to bone products is of great importance.

One of the large uses of phosphate rock is for this purpose and it is rapidly growing as the trade ascertains the truth regarding its proper use.

One of the first firms to recognize the value of phosphate rock, as not only a safe, but actually a beneficial substitute for a part of the bone products used, is the Moorman Manufacturing Co., of Quincy, Ill. E. V. Moorman, president of that company, has given the writer the following statement:

During the last eight or ten years we have carried on almost an endless amount of research and experimental work on rock phosphate, with special attention given to fluorine. This work has covered practically all kinds of farm animals, such as hogs, fattening and dairy cattle, poultry and sheep, using white rats as an approach to the problem.

The most impressive work that we have carried on is what we call our generation test on hogs and dairy cattle. A large herd of brood sows is now going into the 14th or 15th generation with what we regard as a safe amount of rock phosphate added to their ration.

While there are absolutely no observable detrimental effects in any way whatsoever, the outstanding results in favor of a mineral mixture which includes rock phosphate, of the grade known to the trade as lime phosphate, all the way through are not only better growth, but more dependable reproduction, more uniform litters as to size and strength, ability to withstand diseases, etc. In principle there have been secured about the same results with a dairy herd, which has progressed into its fifth year.

Progress in Commercial Flotation

Probably the outstanding development in the phosphate industry is the application of the oil flotation process by the International Agricultural Corp. to the Tennessee fields. The increased recovery possible will widely influence the value of phosphate deposits both in Florida and Tennessee.

The following statement is authorized by John Burrows, vice-president of the International Agricultural Corp.:

In the last few years the flotation of phosphates has passed from laboratory research that pointed toward many possibilities to the severe test of commercial operations on a comparatively large scale.

Starting with the original and basic patent, the International Agricultural Corp., in conjunction with the Mineral Separation N. A. Corp., and later the Phosphate Recovery Corp., conducted exhaustive research work over a considerable period. Then followed a fair sized pilot plant where the process was, in a measure, perfected. The first single unit flotation plant was built shortly after and, as is usual with all new process plants, was finally completely revamped as one important discovery followed another.

The conditions and problems encountered were entirely different from those usually met in metallic flotation. Old practices and theories, as to methods of addition of reagents, pulp densities, time and capacities, did not apply, especially in the flotation of the Florida phosphates. Even standard equipment was not always suitable so that some had to be changed or even designed and built.

The second plant at Mulberry, Fla., embodied all the experience accumulated in the first one, but in the two years of its operation this latter plant has been greatly simplified, until now more tonnage is treated with better metallurgy with about half of the original equipment.

In the laboratory new reagents and methods were developed at the company's well equipped research department.

The Florida plants turn out a remarkable quantity of concentrate, in fact the No. 2 plant produces about the same tonnage per 24 hours as one of the largest copper flotation mills in this country.

This year a unit was constructed at Wales, Tenn., for the flotation of brown phosphate and has been in operation for several months.

In general, the flotation process has been used to date, to reclaim high grade concentrate from current Florida phosphate washer waste and is also being used to work old tailing dumps. In Tennessee the process is being used to recover high grade brown phosphate concentrate from otherwise non-commercial deposits and is also used to split a mediocre grade into a high grade fraction, leaving a smaller fraction of low grade tailing which has local uses.

The future of the process is tied up with constantly increasing demands for high grade phosphate and the fact that the natural high grade sources and tonnages are being rapidly depleted in both Florida and Tennessee.

This statement showing the possible large increase in the assets of the International Agricultural Corp. in the shape of many more tons of recoverable phosphate in its holdings may well be of great comfort to stockholders of the company, giving rise to reasonable expectation of decided increase from its present low market quotations, when the real truth of the enormous intrinsic value of its assets in phosphate rock are known.

Phosphoric Acid

The second largest consuming channel for phosphate rock is the manufacture of phosphoric acid and phosphorus chemicals by the electric furnace and pyrolitic furnace processes and with the entry of these producers into the fertilizer trade with their surplus phosphoric acid, this bids fair to soon assume first instead of second rank.

A representative operator of the first named process is the Swann Chemical Co., Federal Phosphorus Division, of Birmingham, Ala.

Mr. Swann began the electric furnace production of phosphoric acid from phosphate rock at Anniston, Ala., some 14 years ago and his interest in the phosphorus compounds line has expanded to include a number of the old producers by various processes, and this combined interest is now a very large purchaser of Tennessee phosphate rock, besides using a quantity of Florida phosphate.

Several years of intensive research in the Swann Chemical Co.'s Anniston, Ala., works have culminated in the development of a commercially economical process for the production of highly concentrated, soluble, complete, controllably drillable and effectively non-caking fertilizer. All rates of nitrogen, phosphoric acid and potash have identical drillability. The product is in the form of cylindrical particles about 5/64 in. diameter and ¼ in. long. Every particle is of substantially uniform shape, size and analysis, providing assurance of accurately controlled application substantially to each plant, both in quantity and quality. The total soluble and available plant food ranges from 64% to 74%, depending upon the ratios.

This process starts with phosphoric acid, ammonia and potash salts, effects the chemical combinations to neutral solids, and forms them into uniform shapes of finished product in a straight line process. New equipment had to be developed to render this process practicable and commercial. Apparatus, process and product patent applications are pending covering this development. Several hundred reports of actual field tests conducted on sample lots of this fertilizer have proven its distinctive advantages in application.

The same company has developed and placed in commercial operation a process for manufacturing a completely water soluble meta-sodium phosphate.

The Swann company has never so far as known purchased any phosphate properties, probably because the present low price at which Tennessee producers are selling their product is still below production cost.

The class of pyrolitic furnace producers is well represented by the Victor Chemical Works of Chicago, Ill., which operates a large plant at Nashville, Tenn., where it utilizes phosphatic rock in the production of phosphoric acid and phosphate salts. This plant was built in 1921 and depended, originally, altogether on sulphuric acid as the medium for extracting the phosphoric acid from the rock. For this purpose a special sulphuric acid plant was built in connection with the phosphate works. About three years ago the plant was very largely increased by a furnace installation which produces phosphoric acid from phosphatic rock by the pyrolytic process. This plant has been extended, and is at the present time the largest single unit for the production of phosphoric acid in the world. Besides phosphoric acid and phosphatic salts, the Victor Chemical Works produces yellow phosphorus, and during the past year it has added a plant for the manufacture of triple superphosphate for fertilizer purposes. This was the first time that phosphoric acid, made by a furnace process, was used for a large scale manufacture of a fertilizer material in this country.

A large tract of phosphate lands personally selected and combined by the writer in the Scott's mill section of Maury county, being part of the Mt. Pleasant field, was taken over by the American Phosphate Co., organized by Philadelphia people and operated from 1899 to 1902, when the depression incident to the Boer war made operations no longer advisable.

The company was reorganized into a holding company under the name of the Globe Phosphate Co., which in 1914 sold the plant site of some 140 acres to the Hoover and Mason Phosphate Co.

The development was made accessible by several miles of railroad connecting with the main line at Ridley, near Mt. Pleasant, operated by the Louisville and Nashville Railroad Co. for the past 32 years.

This property comprises some of the deepest faces of high grade phosphate rock ever opened up in the Tennessee field.

During 1931 Victor Chemical Works acquired the Globe Phosphate Co., still owning 2200 acres of the above phosphate rock property in Maury county. The Victor people also purchased the Pitts property, comprising 400 acres, also in Maury county. These properties, added to their holdings in Giles county, give the Victor Chemical Works a substantial acreage of phosphate rock properties, sufficient for their requirements over a number of years to come.

Western Phosphate Developments

One of the operators in the western phosphate field furnishes the following statement:

Shipments of phosphate rock from Idaho for the year ending September 1, 1931, aggregated 1130 cars or about 62,000 tons, while during October and November, 1931, about 13,000 tons were shipped.

Presumably therefore the 1931 tonnage was about the same as 1930 when 68,000 tons was shipped.

The development of the large superphosphate plant at Trail, B.C., previously recorded in Rock Products accounts for a considerable part of the above shipments, the remainder going to the Anaconda, Mont., plant in the main, with smaller shipments to the San Francisco Chemical Co.

It is expected that the coast and intermountain country is going to take a large amount of lime phosphate for direct application and prospects of getting a share of the Japanese consumption of phosphate rock appear favorable.

The Teton Phosphate Co., of 613-615 First National Bank building, Boise, Idaho, owning large claims in Teton counties of Idaho and Wyoming, under direction of F. P. Van Hook, are starting operations in the production of finely ground lime phosphate for direct application to western soils.

Associated with Mr. Van Hook is S. K. Atkinson, a well known mining engineer with considerable experience in phosphate developments.

General Comments

Reports have been made during the year of sale of certain large holdings in the Tennessee field, which are not entirely accurate.

Operation of the American Agricultural Chemical Co.'s phosphate mine at Spring Hill, Tenn., has been discontinued and the plant dismantled. It is not true that the property has been sold.

The railroad rate situation, commented on last year, taking Florida rock to Memphis and St. Louis, was finally approved by the Interstate Commerce Commission, and now efforts are under way to equalize this situation by cheaper rates from the Tennessee field.

The recent decision of the Interstate Commerce Commission on the general increase of freight rates adversely affected phosphate rock by a raise of freight amounting to about 12 c. per ton.

The reported use of sodium silicate and other chemical reagents for improvement of the washing process referred to in these columns last year is still unverified, but the process is said to be in use.

One company, which does not give out any information, is said to be sintering or nodulizing in a rotary kiln its waste mud pond phosphate, the same product on which the oil flotation process is used by the International Agricultural Corp.

Conclusions

For the past 30 years the phosphate industry has refused to see its great opportunity and thereby has failed to experience the profitable expansion open to it.

Whether from its present depression, it will now seize that opportunity and rise to a height never before considered possible, or whether it will tag along in the same way as in the past, remains to be seen.

Thanks are due and hereby accorded to the following who furnished various facts of material assistance in the preparation of this paper:

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John Burrows, vice-president, International Agricultural Corp., New York City, N. Y.
Horace Bowker, president, American Agricultural Chemical Corp., New York City.
Anthony Arnold, vice-president, American Agricultural Chemical Co., New York City.

New Uses for Slag Brighten Future

THE TIME may come when slag will find so many other industrial outlets that it will cease to be a serious factor in the aggregate industry. Few raw materials, apparently, have brighter prospects. In the meantime, however, new slag plants for making aggregates appear in the picture each year. The year 1931 was no exception, notwithstanding the fact that only about 50% of existing plant capacity was utilized.

The production of slag for the past year followed very closely the lowering tonnage trends of the other aggregate industries. According to a summary from questionnaires returned there was a drop in production of 30% compared to 1930. In some favored localities a few producers reported a slight increase. Prices also dropped between 20 and 25%. The variations in individual plant prices ranged from 60% less than 1930 to a slight increase in price over the previous year. Plants operated at 48% capacity. Wages of employes were cut from 10 to 25%, with practically all producers making cuts. Labor conditions are considered satisfactory to the employer.

Apparently the members of the slag industry do not expect a quick return to a higher or normal wage level, judging from reports received, and owing to the recessions in volume and price, the labor requirements, in addition to being seasonal, averaged about 45% of 1929 requirements.

Plants were maintained in keeping with the tonnages produced and 1932 operators expect to carry on at about the 1931 levels in this regard.

New Plants

The construction of new plants in the slag industry, in spite of the depression, went ahead, signifying an optimistic outlook for the years ahead. The Weirton Steel Co., Wheeling, W. Va., during the year has constructed a new slag plant at Holliday's Cove. The Birmingham Slag Co. rebuilt the screening plant destroyed by fire last year at Ensley, Ala. The Roquemore Gravel Co., Montgomery, Ala., made its first venture into the slag industry by the construction of a crushing and screening plant at Bessemer, Ala. This plant is reported to have a capacity of 50 cars per day and will wash all the aggregates produced. Allis-Chalmers crushers are used. For screening Nordberg vibrating screens are installed, and for removal of iron a Cutler-Hammer magnetic separator is included. Material at the slag pile will be handled by a Bucyrus-Erie shovel and an American Locomotive engine.

New plant of Birmingham Slag Co. at Ensley, Ala.

The Birmingham Slag Co. at Ensley built its new screening plant of steel throughout. The equipment includes two inclined skips that deliver the crushed slag from the old crushing plant to the top of the new screening unit, where the material flows by gravity to the vibrating screens. Allis-Chalmers, Niagara, and Traylor vibrating screens are used for preparing the sized slag aggregates.

A feature of the operation is the elimination of dust by the installation of suitable dust-collecting equipment. A 44-in. American Blower Co., Sirocco exhaust fan powered by a 75-hp. General Electric motor receives the dust from the various parts of the plant and delivers it to collectors of the cyclone type.

Below the bins a conveyor belt operates which receives aggregate and delivers it to a 5-ft. by 8-ft. single-decked vibrating screen provided with a ¼-in. wire cloth deck. Water is sprayed on this screen so that any adhering dust is removed. By use of this belt blended slag aggregates can be washed and loaded to cars.

This company also contracted to handle the output of the slag plant of the Sloss-Sheffield Steel and Iron Co. The latter company, however, continues to operate its ready-mixed concrete plant and to draw its slag aggregate from its own plant.

New Uses for Slag

Considerable experimental work was reported as being conducted by the Ohio State University using basic slag as a fertilizer. This material, owing to its porous nature, held moisture over long periods of time and thus made an excellent root former. It also reduced acidity of soils and tended to loosen compact clay soils.

The Alabama Polytechnic Institute, Auburn, Ala., did some work on the use of slag as a source of raw material for glass manufacture. It was reported that such use was practical and that the glass so made was of suitable quality.

The process has been tried out in large scale laboratory tests. The process, in essence, consists of fusing 7 parts of granulated slag, 8 parts of sand, 1.76 parts of soda ash. Five parts of sodium hydroxide to 40 parts of mix is then added to reduce scum formation. Sulphur is removed by the addition of about 1% of arsenic trioxide, which at the same time oxidizes the iron to the less objectionable ferric condition. The sulphur and arsenic ore volatilized as arsenic trisulphide or pentasulphide.

E. J. Levino and Co., at their Philadelphia, Penn., slag plant continue researches toward the development of a technique whereby slag can be used for roofing granules.

Increasing amounts of granulated, pulverized slag are being used with portland cement and lime in various masonry mortar cements, placed on the market throughout the country under a variety of trade names.

Research Work of the National Slag Association

By Fred Hubbard
Director of Research, National Slag Association, Youngstown, Ohio

THE National Slag Association has during the past year continued to follow its policy of planning and executing research studies of such a nature as to be valuable not only from a research but also from a practical point of view. The testing laboratory has continued to carry on routine testing of slag from many sources planned to be of particular value to the producers in the actual control and output of their product. This is considered one of the most important functions of the laboratory.

Aside from this much work has been accomplished along lines which would be classified more definitely as research. A very comprehensive study has been made on a group of fine and coarse aggregates in an attempt to ascertain the relation between various physical and chemical characteristics of the aggregates and the quality of resulting concrete made from these aggregates.

In this study particular emphasis was placed on the determination of soundness in the aggregates and the resulting concrete and mortar. Very comprehensive soundness tests were made on sands as well as on the coarse aggregates. Soundness tests were made by using the sodium sulphate method and also actual freezing and thawing. These tests were made on various sizes and combinations of sizes of the materials, the resulting data being very valuable in determining the effect of the method of test upon the results obtained.

Only freezing and thawing tests were made on the cement mortar and concrete specimens. These tests were carried to 200 cycles and were made on 2-in. mortar cubes and on concrete blocks semi-circular in form containing approximately 150 cu. in. Each cycle was composed of a 22-hour period of freezing and 2 hours thawing in water.

The freezing tests were made in an ice cream cabinet with an average temperature in the freezing compartment where the specimens were placed of +30 deg. F. at the start of the freezing period, +25 deg. F. at 6 hours, +20 deg. F. at 8 hours, +16 deg. F. at 12 hours, + 8 deg. F. at 18 hours, and +3 deg. F. at 22 hours. Once each week the specimens remained in the freezing cabinet for 46 hours. The thawing was done in water with an initial temperature of approximately 90 deg. F., which after one hour was reduced to 60 deg. F.

Blocks of concrete were also made for outside exposure tests, the concrete being placed so as to receive the effects of extreme climatic changes.

This investigation included the fabrication and testing of 168 mortar briquettes for tension tests, 168 mortar cubes for compression tests, 56 mortar cubes for soundness tests, 29 concrete yield tests, 36 concrete blocks for soundness tests, 348 6x12-in. concrete cylinders for compression tests, and 116 6x6x40-in. concrete beams for transverse tests.

The question of volume change in concrete and the effect of aggregates upon this volume change is of importance to the mineral aggregates producer providing this characteristic can be compared with its effect upon the quality or durability of the concrete. In order to study the effect of blast-furnace slag on this characteristic of concrete an investigation has been inaugurated in which slags from 12 different sources have been used. These slags were carefully selected to give as wide a range as possible in unit weight, some being lighter than would be permitted by specifications for highway construction.

Changes in volume measurements are being made to ascertain the effect of moisture content and temperature on the change in volume. Measurements are taken on 4x4x30-in. beams, the measuring points being placed on the ends of the specimens. These measurements show the change in length to 1/10,000 of an inch.

Complete chemical and physical tests have been made on all aggregates, one sand being used throughout. This investigation necessitated the making of 36 concrete yield tests, 216 6x12-in. cylinders for compression tests and 80 4x4x30-in. concrete beams for change in volume measurements.

Comprehensive studies have been made of methods of test for the determination of the apparent specific gravity of blast-furnace slag. On account of variations in the density of individual pieces of slag, the standard method of test, which uses a 1000-gram sample, does not give accurate results because of the difficulty in selecting so small a sample which is representative of the entire product. The making of the specific gravity test on larger quantities has been found to give much more accurate and consistent results. In this study slag from many different sources was used having a wide variation in unit weight, the advantage of using the larger samples being very apparent throughout all of the materials studied.

The National Slag Association considers the work of the laboratory during the past year to have been very much worth while in providing data on blast-furnace slag and slag concrete of both technical and practical value.

Vibrating screen with dust collecting hood in new Birmingham Slag Co. plant

Stabilization of the Mineral Aggregates Industries

By J. R. Thoenen

IT IS the considered opinion of many prominent engineers, bankers, economists and business men that the recurrent prosperity peaks and depression dips characteristic of the curve of American business are avoidable nuisances and therefore a useless waste of time, energy and money.

Recently opinion has inclined more and more toward the necessity of some sort of business control or stabilization. In fact, press reports indicate such a movement is already on foot and will appear as legislation introduced in Congress.

Several plans have been publicly advanced for the control of production, stabilization of industry, or whatever you may desire to call it. In none of those with which the author is familiar have details been worked out or offered wherein the safeguarding of free competition and individual initiative are assured under control.

The following notes and comments are offered as bearing on the general subject of business control among the widespread major nonmetallic industries culminating in a suggested detailed plan of operation. The author's object is to arouse constructive comment and criticism from which eventually a final workable scheme may be evolved. In considering the suggestions made herein it is assumed that the present anti-trust laws will be so altered as to sanction legislation enabling the suggestions made to be carried out.

Swope Plan

Stabilization of industry involves several things other than actual limitation of the tonnage or units produced. Gerard Swope, president of the General Electric Co., has ably considered these things in his proposed industrial stabilization plan presented to the National Electrical Manufacturers Association on September 16, 1931. As pointed out in this paper in order to stabilize production, consumption must also be stabilized or at least coordinated. Stabilization of consumption involves stabilization of the purchasing power of the consumer and this in turn involves stabilization of the earning power of the consumer. To accomplish these things Mr. Swope proposes:

1. To establish life and disability, pension and unemployment insurance for employes.

2. These benefits to accrue on a lifetime of effort irrespective of changes of trade or employment.

3. Plans for the preceding to be evolved by representatives of employer, employe and the public acting through the trade association.

4. Establishment of a balance between production and consumption through control of production within the trade association and under the approval of a federal supervisory body.

5. Public protection to be afforded by filing with the federal supervisory body of periodic and uniform financial statements of producing companies coordinated with those filed for taxation purposes.

6. That the industry itself through management-employe cooperation establish this stabilization or control rather than leave it to come through conflicting exactment by state legislatures.

As a suggested plan of procedure he proposes:

1. The formation of trade associations for all industrial and commercial companies doing interstate business.

2. These trade associations may outline trade practices, business ethics, methods of standard accounting and cost practices, standard forms of balance sheet and earnings statements, etc., and may collect and distribute information on volume of business transacted, inventories of merchandise on hand, simplification and standardization of products, stabilization of prices and all matters which may arise from time to time relating to the growth and development of industry and commerce in order to promote stabilization of employment and give the best service to the public.

3. The public interest shall be protected by the supervision of companies and trade associations by the Federal Trade Commission or by a bureau of the Department of Commerce or by some federal supervisory body specially constituted.

4. All companies shall be required to use standard accounting and cost systems and standard forms of balance sheets and earnings statements as adopted by the trade associations.

5. Uniform quarterly statements and annual statements to be made and filed with the supervisory body and sent to each stockholder.

6. Cooperation between the federal supervisory body, the Internal Revenue Bureau and the trade association.

7. Membership in trade associations to be compulsory within three years.

8. Establishment of standard workmen's compensation act.* Life and disability insurance. Pensions. Unemployment insurance.

The Swope plan outlines in considerable detail the provisions for employe protection as listed under No. 8 above. To this the writer offers no criticism.

To some of the preceding proposals the following remarks are directed:

Under paragraph 1, membership in trade associated is limited to companies doing an interstate business. In the mineral aggregates industries which we are considering, such limitation might conceivably create an embarrassing situation. As an example: Many large consuming centers such as, say, the city of Chicago are served by producers in several states. In this particular case, Illinois, Wisconsin, Michigan, Indiana and Ohio. In addition, there are other Illinois companies which sell in Chicago but do not sell beyond the boundary of the state and are therefore not engaged in interstate traffic. If they be excluded from the trade association either by lack of qualification or their own choice, under whose jurisdiction will they come for production control?

Presumably they will have a free hand in the Chicago territory up to the limit of their capacity and only that portion of the market over and above what they can supply will come under the jurisdiction or control of the trade association. It is assumed for the moment that the only reason for producers outside the state entering the Chicago market is the physical inability of the local in-

*For details under this heading refer to Mr. Swope's published plan.

Editors' Note

MOST PLANS for stabilization of industry deal in generalities. This one takes the well-known Swope plan and applies it specifically to the mineral aggregate industry, with modifications adapted to such a local industry.

Here is a subject, the most vital before industry today, discussed in such specific and pertinent terms that every producer can follow it. At least it is something definite to shoot at. That is what we need most today.

Obviously we shall never arrive at anything so long as we stick to generalities. We can wait for a return of "good times" and try to "cash in" as we always have, or we can plan industry so that good times are normal times. Which will it be?—The Editors.

trastate producers to supply that demand. Confining industrial control by trade association to interstate commerce would thus place the local producer in a favored position with respect to local markets. This is very probably a laudable and justifiable aim. However, such a decision also has its complexities.

Let us assume an intrastate producer in Illinois ships to Chicago on a rail-freight rate of $1 per ton. An interstate producer ships into Chicago over a water freight rate of 50 c. per ton. Assuming production costs are equal, the interstate producer can underbid the intrastate producer by 50 c. per ton and equal his profit. Conceding equal quality of product, it is hardly fair to the Chicago consumer to eliminate the interstate producer in this case until the capacity of the intrastate producer is satisfied. In fact, it can be readily seen that such regulation carried to the extreme would practically eliminate interstate traffic and raise the consumer cost way above a reasonable figure. Such restriction of competition would benefit a few local producers at the expense of the consumers.

Evidently any plan of stabilization to be successful must provide for an equitable allocation of tonnage in the face of the conflicting interests cited above.

Paragraph No. 2 is the one to which the writer wishes to direct particular attention. As written, the scope of the trade association's activities are left as rather broad statements without indication as to what methods should be used in accomplishing them.

The language of this paragraph states that these trade associations "*may* outline trade practices," etc., and "*may* collect and distribute" information on certain things pertaining to the industry. There is a total lack of inforcement authority in the language of this paragraph, although intimated in one form or another in each subsequent paragraph. It would be interesting to know why this item has been omitted here. It is also pertinent to ask how any trade association may stabilize industry by simply collecting and distributing data on that industry unless it has some form of governing or regulating authority.

I submit that the language of this paragraph should be changed by substituting the word "shall" for "may" in each case. This change puts the responsibility for compilation of trade practice outlines, business ethics, methods of standard accounting, etc., directly up to the trade association where it belongs, if it is to have governing authority. The same change in the next sentence makes it obligatory upon the trade association to collect and distribute that business information which is necessary to enable it to adjudicate controversies or devise rules of control in the stabilization of its own industry. If the trade association is to stabilize its industry by production control it must necessarily have access to all available information concerning that industry. This does not necessarily imply that the trade association shall take upon itself the burden of collecting all these data.

At the present time much information of this nature is already being collected by various governmental agencies. As examples: the U. S. Bureau of Mines collects annual statistics of production and accidents. It also makes detailed studies of operating costs. The Bureau of Foreign and Domestic Commerce is constantly collecting data on market conditions. There is no reason why this collection of data should be duplicated. The function of the trade association should be to avail itself of all these data and by careful study and interpretation apply the lessons to be learned therefrom to its own local problems. It should then set up such machinery as is necessary to supplement these available data with any local information not already of record but nevertheless pertinent to the solution of local problems of control.

Paragraph 3 may be passed without comment other than a clarifying statement that the trade association shall be empowered by the proper legislation to regulate production within its industry under the supervisory regulation of the selected government agency, from whose final decision appeal could be made to the proper federal court.

Paragraphs Nos. 4, 5 and 6 need no comment.

Paragraph No. 7 requires any company operating in interstate trade to adopt the provisions of the plan within three years unless the time be extended by the federal supervisory body. In the mineral aggregates industries many plants are built, operated and abandoned in less than three years. Therefore such a long period of grace could easily totally disrupt the entire control machinery in these industries. In many instances plants are erected to supply materials for particular road construction jobs which may be completed in less than one season. It is therefore suggested that this period of three years be altered to six months as applied to the industries under consideration. This shall apply to companies entering at the start of the plan as well as those organized after the plan has become effective.

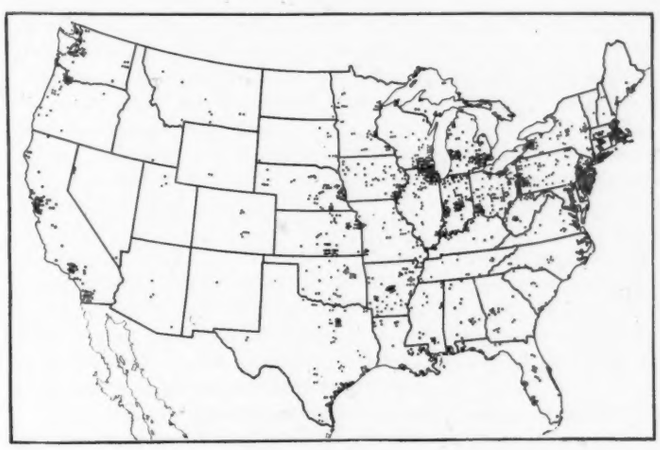
Paragraph No. 8 constitutes a detailed description of the method of organization of benefits for the protection of labor and to this the writer offers no criticism, being content to subscribe to the plan as outlined.

Plan Recommended for the Mineral Aggregates Industries

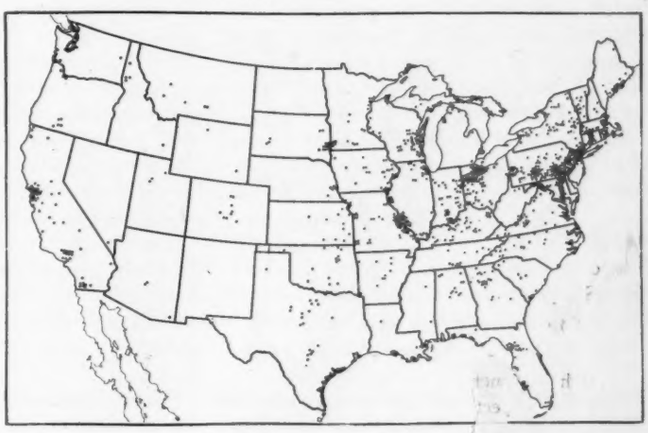
To say that the trade associations shall stabilize their industry under the supervision of a designated federal supervisory body without setting up the necessary organization for such control leaves the matter rather up in the air. The following plan is offered as better fitting the needs of the mineral aggregate industries but at the same time closely paralleling the Swope plan.

Before proceeding to outline the plan, reference is made to the accompanying two maps of the United States on which are shown the locations of the principal producers of crushed stone and sand and gravel.

With such a large number of operators scattered over such wide areas it would be obviously impossible for a single committee of a few members within the trade association to successfully handle local problems of control. For this reason it is the writer's suggestion that trade association control be



Location of sand and gravel plants of more than 25,000 tons annual capacity



Location of crushed stone plants of more than 10,000 tons annual capacity

organized and operated through divisional branches, each of which shall be under the supervision of the national association.

In order to avoid as far as possible questions of "states rights," the districts should be designated by consumption areas and delineated by county boundaries or radial distances from the centers of those consuming areas rather than by state boundaries.

The plan is then as follows:

1. All producing companies (including subsidiaries) with 25 or more employes, and doing an interstate business, shall form a trade association which shall be under the supervision of a federal body referred to later.

2. (*a*) These trade associations shall be empowered by proper legislation to control, and regulate production of the particular commodity with which the association is connected and so coordinate that production with consumption as will stabilize that industry for the greatest benefit of operator, employe and the public.

2. (*b*) They shall outline rules for trade practices and business ethics and have power to enforce them when adopted within their industry.

2. (*c*) They shall initiate and set up uniform methods of accounting and cost practice, standard forms of balance sheet and earnings statements, and assist their membership in adopting and using such forms.

2. (*d*) They shall collect and distribute among their membership information on current and prospective markets, volume of business transacted, inventories of merchandise on hand, simplification and standardization of products, stabilization of prices and all other matters which may arise from time to time relating to the growth and development of their industry and commerce in order to promote stabilization of employment and production therein and assure the best service to the public. Nothing in this section shall operate to make collection obligatory on the association of data which are already collected and made available by other organizations.

3. The public interest shall be protected by the supervision of operating companies and trade associations by the Federal Trade Commission or by a bureau of the Department of Commerce or by some federal supervisory body specially constituted.

4. All companies within the scope of this plan shall be required to adopt standard accounting and cost systems and standardized forms of balance sheet and earnings statements as set up by their trade association.

5. All companies with participants or stockholders numbering 10 or more and living in more than one state shall send to their participants or stockholders and to the supervisory body at least once each quarter a statement of their business and earnings in the prescribed form. At least once each year they shall send to the participants or stockholders and to the supervisory body a complete balance sheet and earnings statement in the prescribed form.

6. The federal supervisory body shall cooperate with the Bureau of Internal Revenue and the trade associations in developing for each industry standardized forms of balance sheet and income statement, for the purpose of reconciling methods of reporting assets and income calculated for federal tax purposes.

7. All of the companies of the character described herein may immediately adopt the provisions of this plan but shall be required to do so within six months unless the time is extended by the federal supervisory body. Similar companies formed after the plan becomes effective may come in at once but shall be required to come in before the expiration of six months from the date of their organization unless the time is extended by the federal supervisory body.

8. For the protection of employes the following plans shall be adopted by all these member cmpanies:

(Identical with Swope plan.)

General Administration

Each trade association shall form a general board of administration which shall consist of nine members, three to be elected or appointed by the executive committee of the association, three to be elected by the employes of the member companies and three representing the public to be appointed by the federal supervisory board. The members of the general board, except employe representatives, shall serve without compensation. The employe representatives shall be paid their regular rates of pay for time devoted to board work and all members shall be paid traveling and subsistence expenses while on board business, all of which shall be borne by the trade association.

The powers and duties of this general board shall be:

1. To interpret the life and disability insurance, pension and unemployment insurance plans adopted by the trade association and approved by the federal supervisory body.

2. To supervise the district boards of administration as elected and set up by the companies operating within their respective districts.

3. To form and direct a pension trust for the custody, investment and disbursement of the pension funds.

4. To have general supervision and direction of all activities connected with employe's life and liability insurance, pension and unemployment insurance plans.

Because of the fact that stabilization of the mineral aggregates industries must originate and be applied at the widely scattered consuming centers the trade associations shall organize local or district branches of those associations.

The trade association shall divide the territorial United States into such areas or districts as may be convenient for administration and control purposes having due regard for the location of consuming centers therein.

The trade association shall define district boundary lines and alter the same from time to time as conditions require.

It shall confer with trade associations of competing materials in selecting district boundaries in order to facilitate cooperation in control of production.

Each district branch of the trade association shall form a district board of administration which shall consist of three members, one appointed by the member companies, one elected by the employes of the member companies and one representing the public, to be appointed by the district branch of the trade association.

The members of the district boards shall serve without compensation. Travel and subsistence expenses while engaged in board business shall be borne by the district trade association.

The powers and duties of the district boards shall be as follows:

1. To supervise the individual company boards of administration.

2. To assist the general board in the supervision, direction and interpretation of all things connected with the promulgation or operation of employe's life, and liability insurance, pension and unemployment insurance.

3. To engage such clerical or other assistance as may be required from time to time.

District Branches of the Trade Association

Upon the district offices of the trade association will fall the brunt of the solution of stabilization in the industries under discussion. For this reason it may be well to outline some of the powers and duties of the division offices.

1. District branches of the national trade association shall be organized in such districts as are designated by the national association.

2. The scheme of organization of these district offices shall follow a standard form as instituted by the national association except that the extent or detail of that organization may be determined by the member companies in the particular district with full recognition of the needs of the district.

3. The district offices shall assist the national association in promulgating trade practices, business ethics, methods of standard accounting and cost practice and standard forms of balance sheet and earnings statements.

4. They shall receive from the national association or other source such statistical information as is available concerning their industry, study the same with respect to its influence or assistance to their particular district and distribute it together with their comments to member companies.

5. They shall collect, tabulate and distribute to member companies any and all possible information within their district

pertinent to their industry not otherwise collected.

6. They shall collect and file for reference but not for publication quarterly statements from member companies concerning their costs of production computed after the standard cost system as set up by the national association.

7. They shall act as sales agents for all member companies.

8. They shall allocate sales among member companies in such ratio as shall have been agreed upon between the various companies at the beginning of each year.

9. They shall have authority to allow or forbid the commencement of new production within the district as consumption warrants.

10. They shall have power to confer with district boards of competing trade associations and with them reach mutual decisions concerning division of tonnage of competing materials

Operation of District Offices

In order to assure proper distribution of tonnage sales and at the same time preserve competitive stimulus to individual initiative the following plan is suggested for operation in district trade association offices:

1. All material shall be sold through the association offices except orders involving less than a stated minimum amount of money which shall be handled by direct negotiation between consumer and producer.

2. The district office shall notify all member companies of impending markets.

3. Member companies shall forward sealed bids to the district office giving a net price f.o.b. plant and also a price delivered at the point of consumption.

4. The district office shall compare bids with production costs as already on file in that office. Bids below filed costs shall be thrown out unless proper explanation accompanies them as required by the adopted code of business ethics.

5. Each low bid will be referred to the tonnage quota of the company tendering it. If that company has already received its allotment of tonnage, its bid shall be struck out and the next low bid referred to the tonnage quota of the company making that bid, and so on. Bids not thrown out will be tabulated and submitted to the requesting consumers.

6. As contracts are awarded on bids the district office shall check off their tonnage against the quota of the company involved.

7. Quotas for the first year of operation under association control shall be fixed by agreement between the member companies.

8. Quotas for each succeeding year shall be based on the mean between the tonnage of its previous quota and the tonnage on which it was low bidder during the preceding year, except as may be modified by the limitations of its productive capacity.

Views of an Optimist

How to Profit in a Business Depression

By John Zollinger
A Sand and Gravel Producer

LOOKING IT UP in Webster's dictionary we find "profit" defined thus: pecuniary gain, benefit, to be of advantage, make improvements. Again consulting the same source of information we find "depression" defined as: cast down in spirits, the act of depressing, dejection, the angular distance of a celestial body below the horizon, a weakening of vitality.

How to profit in spite of all this is actually an impossibility, unless something can be done with that celestial body thing, which no doubt is a rainbow.

We all want to make profits and to do this the last thing to be thought of or mentioned is depression. Perhaps a little illustration will prove my point. A young student had satisfactorily demonstrated a process to make gold out of cheap ingredients and finally sold the process to a certain party. He proceeded to explain to the buyer the secret of the process, which was really very simple, namely to take the ingredients, stir them after a certain fashion, and during this procedure to think of anything at all, but never of an alligator. It is needless to say that the man could think of nothing but alligators. This depression talk has become the father of all alligators. Today if a plant needs new equipment it is not bought; if additional brain power might improve conditions the cost is figured too high, and all because times are changing and we are not adjusting ourselves to this change. The depression is in the individual and the sooner we let the fact sink in that economic conditions have changed and are going to stay changed, the sooner we all will be on the road to profits.

To think that the easy times of nineteen-so-and-so are coming back again is asking too much of Providence; but also to think because it has become harder to do business, profits can not be made is to give way to the last interpretation of depression, namely a weakening of vitality.

At this time it is well to take stock of our assets, the personnel, the heads of the various departments. Are they up on their toes or are they suffering from the malady; it seems to be contagious, and if your sales department has an attack it is well to infuse new blood. Good times have made all of us a little soft, but still I think it will be good times as soon as we make up our mind, that we will have to push the cart because it's going up-grade.

Right now is the time to figure on 1932; how we are going to produce better material, how we are going to get production costs down so that the plant will make a profit at less production; how we are going to adjust ourselves and the business and be ready in the spring. Surely not by being on the bottom of a so-called depression.

Matters of evolution are always slow of movement; we find no trouble adjusting ourselves to better conditions, but get real peeved when the time comes to pay the bill. The time has come, the walrus said, and it will not be an oyster picnic, but economy in the right place, daring decisions by far-seeing men, and the right men in the right places to carry out such decisions.

In closing permit me to add the few lines scribbled at the bottom of the questionnaire which has caused this epistle to be solicited by the editor:

"We have not felt the depression; as a matter of fact 1931 has been the best year in our business. The manufacture of a good product has probably been the reason, since our competitors have done little business. Close cooperation between the production and sales division is imperative in these times. We have not reduced prices and do not expect to do so, but will try to give the customer an even better product.

"Cheer up boys, 1932 will tell a big tale, and the mint is still running. Good luck!"

September Cement Production in Canada

DURING SEPTEMBER, shipments from Canadian cement plants totaled 1,077,923 bbl., while in August 1,109,977 bbl. were shipped and in September last year the total was 1,410,620 bbl. Cement sales during the first nine months of the current year were recorded at 7,778,000 bbl. or 11% below the total for the corresponding period of 1930, the Dominion Bureau of Statistics reports.

Exports of cement amounted to 12,543 bbl. valued at $16,943 in September. Approximately 68.9% of these exports were consigned to Newfoundland.

Canadian Feldspar Production in September

THE Dominion Bureau of Statistics at Ottawa reports feldspar production in Canada during September at 1893 tons as compared with 2160 tons in August and 1944 tons in September, 1930.

Ground feldspar imported into Canada during September totaled 155 tons appraised at $2847; in the preceding month 33 tons worth $448 were imported. These imports were obtained from the United States.

Research in the National Crushed Stone Association Laboratory

By A. T. Goldbeck

Director, Bureau of Engineering, National Crushed Stone Association

AS HAS BEEN OUR policy since the inauguration of our laboratory a little over three years ago, we have continued during the past year to engage in investigations of basic value to the crushed stone industry. Renewed interest in the research work of the Association was instilled through the reorganization of our committee on research which has been given the title of "Research Advisory Committee." It is under the chairmanship of Paul B. Reinhold, of Reinhold and Co., Inc., Pittsburgh, Penn., and its membership is composed of active and associate members geographically located throughout the country.

This committee has held four well-attended meetings and has been organized into 17 sub-committees under the chairmanship of members of the committee. The sub-committees are not, in all cases, composed of members of the main committee but their personnel is geographically distributed as much as possible and is composed of members of the industry selected because of their particular familiarity with the problems with which the sub-committees deal. It is the aim of these various sub-committees to collect as much useful information along their particular lines as possible, to the end that this information might later be digested and given publicity throughout the industry through the medium of the technical press, of our *Crushed Stone Journal,* our "Useful Information" service, through our technical bulletins and through special pamphlets which may be published from time to time as may seem desirable.

Not only is it the duty of the research advisory committee to collect information of a character useful to the crushed stone industry but, in addition, it advises the president and the board of directors of the Association as to what problems it considers most desirable for research in our laboratory. At the beginning of the present year the committee went on record as favoring research along three particular lines, namely, stone, sand, railroad ballast and low cost roads, and, consequently, during the past year we have devoted most of our time to investigations of the above three problems.

Stone Sand Investigation

Stone sand differs from most natural sands largely in the shape of its fragments. Particles of stone sand, because they are produced by crushing operation, are apt to be more angular in shape than those of natural sand. Furthermore, since stone sand is produced as the result of a crushing and screening operation, it is most economical to produce a gradation which best fits the parent product from which the sand is screened. This same statement may also be made with regard to natural sands.

If the quarry from which the sand is produced is composed of entirely satisfactory material, the grains, even those extending down to the very finest dust present, will likewise be sound. Consequently, the finest particles passing the No. 100 mesh are not as objectionable in stone sand as they might be in those natural sands whose fine particles are composed largely of clay. Production equipment is gradually being evolved to such a state of efficiency that stone sand of almost any desired gradation may be prepared within very close limits.

Accordingly, it would be advantageous to know the best gradation from the standpoint of workability of concrete and of maximum strength. We have undertaken this phase of the work in our laboratory. For this purpose we have used a good grade of limestone from Martinsburg, W. Va., having a percentage of wear in the Deval abrasion test of 3.3 and by means of a small Traylor "Bulldog" gyratory crusher and an Allis-Chalmers sample grinder, this stone was crushed and ground to a fine size. It was then separated out into fractions by the use of a "Hum-mer" screen and these fractions were later re-combined in definite proportions so as to form 17 different gradations of sand, varying from very coarse to very fine. The details of these gradations and of the entire investigation will be published at a later date.

Mortar voids tests were then made after the manner described by Prof. A. N. Talbot and, as the result of these tests, mixtures of concrete were designed to give a predetermined modulus of rupture. Finally, concrete specimens were prepared in both beams and cylinders to determine the strength of concrete produced by these several sand gradations and several mixtures. Although the cement content in the various mixtures used varied from approximately 5.6 to 7.3 bags per cubic yard, the modulus of rupture of the various mixtures was reasonably uniform. This great variation in cement content was necessary because of the wide range in gradation of sand used and this well illustrates the desirability of studying gradations in order to determine the most desirable sand to produce.

There was one point which was most decidedly outstanding as the result of the concrete tests made with stone sand, namely, that among the entire 17 gradations studied, only two or three of the concretes could be considered as being non-workable; the remaining mixtures were workable and in some cases even more so than with many natural sands. The workability was judged by eye and by the manipulation of the concrete in the forms. There is no acceptable laboratory test for workability. Engineers seem to be afraid of the possible lack of workability of concrete made with stone sand but certainly this fear is unfounded when the concrete is correctly proportioned to suit the sand gradation and that of the coarse aggregate.

Stability Tests on Railroad Ballast

One of the major investigations conducted during the past year has been a study of the stability of various gradations of crushed stone and of gravel and crushed gravel railroad ballast. One of the primary functions of ballast is to support the tracks and to distribute the load over the subgrade. Primarily, ballast is a load-carrying material and it should remain reasonably stable under the application of load. In actual practice the traffic loads are applied at times suddenly, at times with considerable impact and at times as static loads. In the laboratory the simplest kind of a load test to make is a static load test and, accordingly, in our preliminary studies of the stability of ballast we determined to use a load applied in a static manner.

Our testing machine consisted of a bin 6 ft. square and 18 in. deep and arranged with an overhead I-beam attached to upright supports. The ballast specimen was placed in the bin and subjected to load by means of a calibrated hydraulic jack. A large amount of time was spent merely in finding out how to place the ballast in the bin in a uniform manner so that check load tests might be obtained. Finally, a method was evolved which gave satisfactory results. This consisted in placing the ballast in 3-in. compacted layers, each layer being subjected to the action of a square tamp 9½ by 9½ in. and weighing 27 lb. This tamp was raised 12 in. and was allowed to fall freely, only once in a given spot. Tamping was continued over the entire area of the bin. Six layers of ballast were required to fill the bin, making a total compacted thickness of 18 in. of ballast material.

In performing the tests, a 10- by 10-in.

square bearing block was set on the ballast at the center of the bin and upon this was placed a hydraulic jack graduated to 100-lb. increments up to a total capacity of 20,000 lb. The plunger of the jack was divided into increments of 1/10 of an inch. Loads were applied by pumping the jack slowly by hand so that the average amount of displacement of the bearing block was approximately ¾ of an inch per minute. Simultaneous readings of load and vertical displacement were taken. After the completion of each test, the entire contents of the bin was shoveled out on the floor, re-mixed and replaced as above described. This operation was repeated five times for each gradation of material. It will be seen from the above description that the sample employed was large and involved the use of close to 60 cu. ft. of loose material. A complete description of these tests appears in the November, 1931, issue of the *Crushed Stone Journal* and the results need not be further discussed here.

The indications resulting from these tests are as follows:

1. That crushed stone composed of angular fragments possesses far greater stability than gravel composed of rounded fragments.

2. The use of approximately 15% of fine crushed stone, ¾ in. to No. 4, considerably increases the stability of crushed stone ballast.

3. The inclusion of crushed fragments in gravel ballast increases its stability over that which obtains when merely rounded fragments are used. However, its stability, even when 49% of crushed fragments is present, is considerably lower than that obtained with crushed stone. The maximum bearing value of the gravel ballast is something under half that of crushed stone ballast and is reached with very little displacement of the bearing block.

It would seem that these tests give a good basis for judging of the relative stability of various gradations of stone ballast and of the relative stability of stone and of gravel ballast containing crushed fragments. No doubt somewhat different results are to be expected from other kinds of stone and gravel.

Bituminous Investigations

Low cost roads are becoming an important feature of the highway systems of the country and many different types of bituminous mixtures have sprung into being in the last several years. Because of the importance of this subject, the research advisory committee thought it well to devote a considerable amount of time to researches along this line. One of the problems which needs study is the question of resistance of these several mixtures to the shoving action of traffic, taking into account such variations as gradation, character of fragments used in the aggregate, character of bituminous materials, the relation of thickness of pavement to maximum size of coarse aggregate, the condition of the base, whether wet or dry, smooth or rough, the most favorable percentage of bitumen to use and a number of other questions which come readily to mind.

Accordingly, it seemed necessary to study these mixtures in the laboratory in a manner which would closely simulate their conditions in the roadway surface. A circular track has therefore been built in the laboratory upon which artificial traffic will be run. The base of the track is constructed with reinforced concrete, in the shape of a trough, 14 ft. in diameter, with curbs 6 in. deep and having a roadway 18 in. wide. This base is provided with six steel pipes uniformly spaced and placed within ¾ of an inch of the surface. Through these pipes warm water will be circulated in order to bring the temperature of the bituminous mixture, which will be laid upon the concrete base, up to summer temperatures, say, between 120 deg. and 140 deg. F. For rolling and compacting the bituminous material, a roller approximately 6 in. wide will be used, composed of three cast-iron disks 3 ft. in diameter, 2 in. thick and weighing 400 lb. per inch of width. These three disks are mounted on a single axle at the end of a long arm which will be driven by means of a vertical speed reducer with an electric power drive at a speed of approximately two miles per hour. A reversible motor will be used so that the roller may be moved back and forth in order to complete the rolling. Likewise the roller may be moved in and out across the width of the track and thus the entire width of the bituminous surface may be compacted.

Finally, after the rolling is completed this same machine will be used as a testing machine, employing either the same roller, or if need be, a rubber-tired wheel may be substituted. However, the preliminary tests will be run making use of the roller alone. Arrangements have been made so that the track may be flooded with water and the tests conducted with the bituminous wearing surface in a wet condition. Also, a macadam base may be constructed upon which to lay the bituminous surfacing. In addition, cold water may be circulated through the pipes laid in the concrete base so as to simulate cold weather conditions. This feature of the test may be helpful in studying the brittleness of various types of surfaces.

This apparatus is entirely new and much remains to be found out about its value as a testing machine. Engineers interested in bituminous pavements, however, have expressed the thought that it should prove to be of extreme usefulness and it is our hope that during the coming year results of great practical value to stone producers and to the bituminous paving industry will be forthcoming.

In addition to the three above major investigations, tests have continued on the soundness of mortar and of coarse aggregate, one test having been conducted in cooperation with the Portland Cement Association. Also a number of routine tests have been made on various materials.

Fineness or Particle Size of Portland Cement

INTERESTING INFORMATION on the fineness of cement, given in simple and non-technical language, is contained in a recent article by A. E. Hiscox in the *West Penn Cement Safety News*, published by the West Penn Cement Co., Butler, Penn.

This is one of a series of articles discussing the properties of portland cement and methods of measuring those properties, and their effects.

Whereas two decades ago 100 mesh was considered sufficiently fine, the trend has been continually toward finer grinding until today the 200 mesh test is used by most manufacturers only for checking against the requirements of the standard specifications. They are now interested in the 325-mesh fineness or the makeup of the cement in terms of microns.

The present standard specifications for fineness state that the residue on a 200-mesh sieve shall not exceed 22%, and the U. S. government specifications limit this residue to 20%.

The 200-mesh test, however, does not of itself show the size gradation of the particles passing 200-mesh and may be misleading since cement can be ground so that it will all pass the 200-mesh sieve and yet have a very low strength. According to some investigators the strength is dependent on the amount of flour or fine particles.

In any case, the size of the particles is of great importance and there is strong evidence that there must be a definite or fairly well defined gradation of particles of different sizes for best results.

Other things being equal the finer the cement the greater its sand carrying capacity and the stronger the mortar produced, but it must not be so fine that it will set or harden too rapidly for practical use. While ordinary portland cement is commonly ground to a fineness of 80 to 90% passing 200 mesh a number of high early strength cements show a fineness of 90 to 98% passing 325 mesh.

This testing for fineness has always been done by using testing sieves of finely woven wire cloth but because of the extremely small sizes of the particles to be measured the air analyzer has been found more practical for the determination of sizes below 200 mesh. This is done by blowing off the fines by an adjusted current of air in a calibrated apparatus.

Of late years a new method of expressing these small particle sizes has come into use. A particle which will exactly pass through the opening in a 200-mesh screen is called a 74 micron size, the term "micron" being used to express a dimension of .001 millimeter or .00003937 in. A standard 200-mesh screen has an opening of .074 millimeter or .0029 in.

Micron measurements will no doubt play an important part in future developments.

Research Activities of the National Sand and Gravel Association

By Stanton Walker
Director, Engineering and Research Division, National Sand and Gravel Association

RESEARCH ACTIVITIES of the National Sand and Gravel Association during the past year have been directed along somewhat different lines than in previous years, on account of the greater number of demands from member companies for the investigation of special problems. This procedure has not been as productive in the development of fundamental information as would a program uninterrupted by special problems, but it has been of considerable value in indicating subjects on which work should be done. Our general investigations, most of which were started prior to this year and which have been mentioned in earlier publications, also have been continued. In this review brief mention will be made of the more important problems which have received consideration during the year. Space will not permit of inclusion of the data; the more complete of these will be summarized in the Sixth Annual Report of the Engineering and Research Division to be presented at the forthcoming convention of the National Sand and Gravel Association.

Accelerated Soundness Tests of Aggregates

With the adoption of the so-called sodium sulfate accelerated soundness test as an acceptance test for both fine and coarse aggregate by an important highway department, a large share of our attention has been directed to studies of this method and to investigations of aggregates by it. It would require too long a discussion to give the background of the development of the various accelerated soundness test methods and to summarize what information is available concerning their applicability to aggregates. It must suffice here to say that the sodium sulfate method appears to offer information of assistance in judging of the ability of most aggregates to resist the destructive action of the weather, but that no definite relationship has been established between the results of this test on the aggregate and the durability of the concrete in which it is used. The lack of this definite relationship, the exceptions to the applicability of the method, and the importance of the quality of the concrete and the nature of the exposure on limits of quality for aggregate, lead to the conclusion that the results of the test should be considered only as an indication and a warning instead of as a definite acceptance test with arbitrary specification limits.

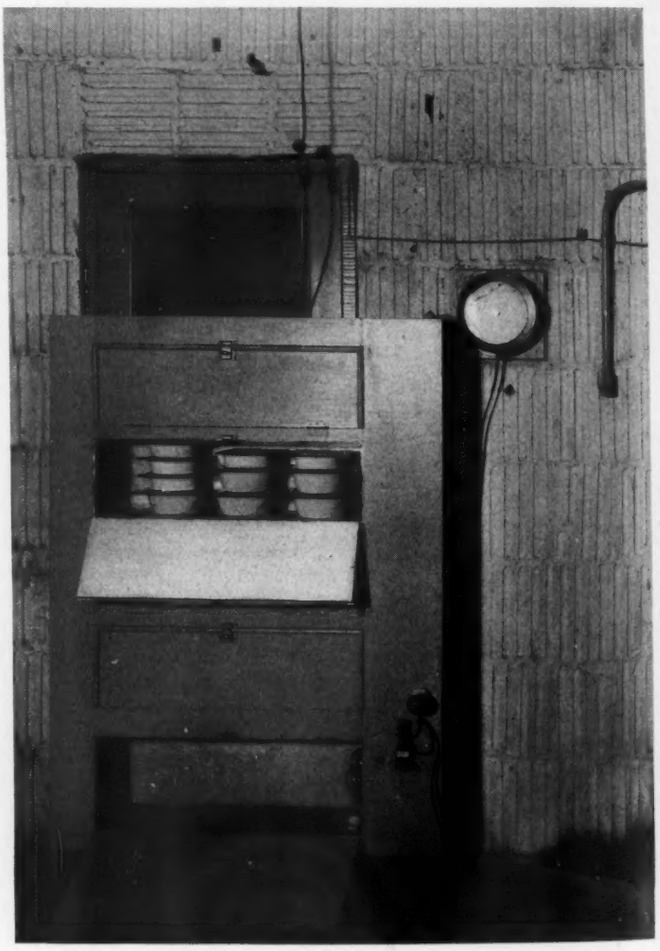
The Sodium Sulphate Method

Sodium sulfate has been used for accelerated soundness tests for a great many years, but it has been only recently that an approximately standard procedure has been developed which is applicable to both fine and coarse aggregates. One cycle of that test* consists of immersing the aggregate in a saturated solution of the salt held at a constant temperature for a period of 18 hours and then drying the sample to constant weight in an oven. In general, 5 cycles are considered to constitute a test. The aggregate is prepared for the test by separating it into several closely graded sizes. Each size is tested separately. Results are measured by determining the loss through the sieve on which each increment of the sample was retained in the preparation of the sample and weighing the losses for all sizes in proportion to the grading of the material as used.

Sources of Error Studied

Investigations of the test method in our laboratory and in others indicated that there are two important features offering opportunity for error which deserve special attention. These are, (1) the method of preparing the sample, and (2) the control of the temperature of the solution.

In the first instance it will be seen that unless the several increments of the sample are prepared with great care, some of the smaller sizes will remain in it and, on sieving after exposure, will appear as loss due to the action of the sodium sulfate. The error from this source is particularly important in the case of fine aggregates. An investigation of sieving methods for the preparation of the sample was conducted and showed conclusively that the method of preparation accounted for much of the disagreement in results from different laboratories; carelessly prepared samples caused the temporary rejection of certain sands which, in reality, gave resistance within specification limits. Our tests indicated that, in the case of coarse aggregates, the preparation of the sample by hand sieving to refusal is satisfactory; in the case of fine



Constant temperature cabinet used in tests

*Tentative Method of Test for Soundness of Fine Aggregates by Use of Sodium Sulfate (C 88-31T) and Tentative Method of Test for Soundness of Coarse Aggregate by Use of Sodium Sulfate (C 89-31T) of the American Society for Testing Materials.

aggregates, we have arrived at the procedure of making a fairly accurate separation by sieving the graded sample through a nest of sieves or through riddles and then resieving each size for twenty minutes in a mechanical shaker using small samples of approximately 100 grams each.

Temperature Control Important

The temperature control of the solution is of particular importance on account of the wide variation in the solubility of sodium sulfate for different temperatures. (At 70 deg. F. a saturated solution of sodium sulfate contains about 17% by weight of the decahydrate form of the salt, and at 80 deg. F. about 26%.) A simple device constructed in our laboratory for the control of temperature maintains a satisfactory degree of uniformity. It is illustrated in the accompanying photograph. Its essential features are the light bulbs used as heating elements, the thermostat for the control of the temperature, the fan to insure circulation of air and a uniform temperature throughout the cabinet, the arrangement of shelves to permit the free circulation of air, and the provision for an ice chamber to balance the heating elements during hot weather.

Uniformity of Tests

After developing a fairly satisfactory testing procedure, studies were made of the accuracy with which the test can be conducted. So far as our laboratory is concerned, satisfactory duplication of results can be obtained. In comparisons with other laboratories fairly good checks have been secured with those who have had sufficient experience with the test to develop an accurate technic and who have proper control apparatus available. Laboratories having a limited experience with carrying out the test have invariably shown erratic results.

A large number of different samples of aggregates have been tested, and it is expected to continue this work until a fairly good cross-section of the materials in common use has been obtained. It is hoped that our further studies will result in more definite information concerning the relationship, or lack of relationship, of the results of the test and other characteristics of the materials. It is also hoped that a more simple testing procedure can be developed.

Study of Local Pit Production

Competition with the production of "way-side" pits has always been a thorn in the side of the established sand and gravel industry. These pits, generally with inadequate production facilities, often appear to afford opportunities to effect economies in construction. In many cases, however, the economies are more apparent than real; production costs are underestimated; the source of supply may not be dependable either from the viewpoint of quality or quantity; the large cost of producing and wasting surplus sizes is left out of account; and the delays and lack of service attendant on getting material from an untried source and, more often than not, from an inexperienced producer are not evaluated.

Minnesota represents a locality in which a large number of local pits have been operated. During the past construction season the Association cooperated with established producers in that state in a study of the problem of way-side pit competition. A competent engineer was employed to observe the production of local and portable aggregate plants and to cooperate with the engineers of the highway department in securing aggregates of uniformly high quality from established as well as local producers. J. W. Kelly, formerly with the Portland Cement Association, was selected to do the work. The results of his studies will be reported before the next annual convention of the Association.

Design of Concrete Mixtures

With the development of information on the factors which control the strength of concrete, greater attention has been paid to the design of mixtures. Among highway groups, with the many combinations of aggregates available, design methods, to the greatest extent, have taken the form of comparisons of different aggregates by trial mixtures. In general, the methods consist of making tests to determine the proportions required for different aggregate combinations to produce a specified flexural strength. For the most part, these tests are carried out under arbitrary conditions using a single brand of cement, selected as standard. These methods, therefore, result in fine-haired distinctions between the strength-producing properties of aggregates from different sources and leave almost entirely out of account other characteristics of the concrete, the large effect of the quality of the cement, and other important factors. We are entirely sympathetic toward a method of design which accurately places a premium on aggregates of high quality, but our studies of the results of designs and some preliminary investigations carried out in our laboratory indicate that present methods often place an undeserved handicap on specific materials.

Factors Affecting Design of Proportions

The general subject of concrete-mixture design will have a prominent place in the program of our forthcoming annual convention and it is not feasible to give an adequate discussion of its many ramifications here. It must be sufficient to mention four important factors, affecting the design, on which some information has been developed. These are, (1) the effect of the time at which the tests are made, (2) the effect of the age at test, (3) the effect of the quality of the cement used as standard, and (4) the effect of the proportioning of the fine and coarse aggregate. The factors listed do not take into consideration the inaccuracies resulting from placing principal weight on strength, neglecting the quality of the cement and other important considerations. They have to do with difficulties in making accurate comparisons, even when these important matters are left out of account.

The effect of the time at which the concrete tests are made is important since common practice is to test different combinations of aggregates in isolated groups at different times. This procedure does not take into account the variations in results which may be obtained on account of unavoidable differences in the condition of the tests. As a result, the competitive relationships of different aggregates may depend to a most important extent on the accidental effect of the time at which they are tested. Tests carried out in our laboratory on identical combinations of aggregates and cement, at five different times over a period of about 18 months, show differences in strength equivalent to about what would be expected for a change in cement content of 1 sack per cu. yd. of concrete. These tests were carefully conducted and it is not believed that other laboratories can obtain a very much higher degree of uniformity; studies of tests from other sources confirm this conclusion. To avoid errors on account of time of test it seems necessary, either to test all aggregate combinations considered for use at one time and under identical conditions, or to test each combination in comparison with an aggregate selected as standard.

The age at test for which comparisons are made must, of necessity, be selected more or less arbitrarily. Studies of our own test data, as well as those from other sources, show variations in comparisons depending upon the age at test. Our studies thus far have not been conclusive in showing a definite relationship, but they are unanimous in indicating that the differences on this account may be sufficient to have an important effect on competitive relationships between aggregates from different sources, if results are interpreted literally.

Preliminary tests carried out on different cements of a wide range in quality indicate that comparisons between aggregates are affected to an important extent by the cement with which they are tested. This point does not bear on the importance of the differences in strengths of concrete made with different cements, but on the differences in comparisons between aggregates tested with the same cement, depending on the cement selected.

The proportions of fine to coarse aggre-

gate have an important effect on the concrete-making properties of different combinations of aggregates and the method used in selecting them becomes of special importance in comparison of materials of widely different gradings and types. Tests carried out in our laboratory bear on this phase of the general question of design of concrete and emphasize its importance.

Characteristics of Aggregates

Our investigation of the effects of characteristics of aggregate other than grading has been continued. This study has involved tests of strength of concrete made with several gravels and crushed stones of high quality and of widely different characteristics. These tests are being made in small groups at different times, each group being tested in comparison with a local material selected as standard. This procedure permits of correlating the results of the different groups and of continuing the investigation over an indefinite period of time. As a part of this study rounded particles are being prepared from crushed materials so that comparisons of crushed and angular aggregates, identical in all other respects, may be made.

Our tests to date confirm the findings of other investigators that surface texture and strength of aggregate particle have an appreciable effect on the flexural strength of the concrete, but that the compressive strength is affected to only a limited extent by such characteristics. The tests are conclusive in refuting the claim made by some engineers that angularity is an asset to the concrete-strength-producing properties of an aggregate. They bring out the advantages of an aggregate with a low-void content, particularly from the viewpoint of the richer mortar and lower water-ratio which may be used with rounded materials, for a given degree of workability and a given quantity of cement.

Tests of Sands

In addition to the accelerated soundness tests mentioned previously, more than the usual attention has been paid to investigations involving sands as fine aggregates for concrete. Brief mention of certain of these tests was made in last year's review and a few test results have been published. Most of the work done this year on this subject was initiated on account of special problems of member companies.

One of the most interesting of our investigations of sands involved comprehensive concrete and mortar tests of two materials which, for identical gradings, required considerable differences in quantity of mixing water for the same concrete proportions. The specification under which large quantities of them were used contained a clause limiting the quantity of mixing water which threatened to eliminate one of them from use in certain common proportions. Our tests showed that the differences in water requirements existed but that the concrete strengths were practically unaffected by them. No completely satisfactory reason for the discrepancy was indicated, although differences in absorption, angularity and void content afforded a partial explanation. Both sands were of high quality, one being essentially quartz and the other consisting of a mixture of quartz and chert.

Another study of sands, on which work has been carried out from time to time throughout the year and for which concrete specimens for test from 7 days to 5 years are being made at the present time, involves materials which appear satisfactory in all respects except that they do not meet the conventional mortar strength requirements. One of these sands offers a particularly interesting study; it is well graded and the reduction in mortar strength is apparently caused by the presence of a thin coating on the grains, of such a nature that it cannot be removed readily by agencies less effective than boiling hydrochloric acid.

The water-carrying capacity of sands of different gradings has been the subject of a preliminary investigation. Interest has been aroused in this question from the viewpoints of variations in weight, estimates of quantities of materials for concrete and the control of the quantity of mixing water in concrete. As would be expected these tests show wide variations in the amount of moisture held by sands of different gradings. They also give interesting and fairly definite information on the rate at which the moisture drains. Since the tests were made on small laboratory samples they can be taken only as roughly indicative of the action of larger volumes.

Tests of Railroad Ballast

Our investigations of gravel for railroad ballast have been continued. Thus far, most of our tests have consisted of the determination of physical characteristics of gravels which are being used as ballast. These tests include sieve analyses, weight per cubic foot, percentage of voids, resistance to abrasion, resistance to crushing, specific gravities, absorptions, and resistance to the action of sodium sulfate in the accelerated soundness test. This work is being done as a part of our cooperation with the committee on ballast of the American Railway Engineering Association and is for the purpose of developing information on which to base specifications.

Standardization of Sizes

The activities in connection with the standardization of sizes of sand and gravel, initiated by our committee on standard specifications several years ago, have been continued. During the year this problem has been attacked in cooperation with the National Slag Association and the National Crushed Stone Association. It is the aim of these three associations to conduct their standardizing activities along similar lines, so far as conditions will permit. The cooperation of the three associations on this problem of mutual interest has already been most effective in promoting uniformity among specifications issued by various national and local standardizing bodies. Specifications for grading of concrete aggregates adopted by the American Society for Testing Materials and the Federal Specification Board and being proposed to the American Concrete Institute are based on sizes approved by our committee and by representatives of the three associations. Many instances of local specifications based on these same standard sizes can be cited.

Standardization of Wire Diameters for Screens

The large number of wire diameters listed in the catalogs of wire screen manufacturers leads inevitably to one of two conclusions: (1) Either screening requirements vary over an extremely wide range and are sensitive to minute changes in size of wire, or (2) a very much larger number of wire diameters are listed than practical considerations dictate. Undoubtedly there is an element of truth in both of these conclusions. Wire screen manufacturers serve several different industries and the requirements of each of them are different. Unfortunately catalogs of wire screen do not attempt to classify the different sizes of wire according to the industry to be served and, consequently, there results considerable confusion in each industry as to what size will best meet its requirements.

This condition was called to the attention of the National Sand and Gravel Association by certain of its active and associate membership. It was suggested that large economies to the manufacturer of wire screens and to the producer of sand and gravel might be effected by efforts directed toward the standardization and simplification of sizes of wire. It was pointed out that the selection of sizes best adapted to the needs of the sand and gravel industry would result in a reduction of stock necessary for the manufacturer to carry and would lead to the more general use of the most efficient sizes.

Discussion of this problem was initiated by correspondence with the principal manufacturers of wire screen. There resulted a practically unanimous expression of opinion that benefit could be derived from a study of it. A meeting of wire screen manufacturers was called and a tentative selection was made of standard stock sizes of wire which, in the opinion of those present, were most used and most adapted to the aggregate industry. This list of sizes has been circulated to

all wire screen manufacturers and has received the approval of practically all of them. The next step will be to circulate the sizes to aggregate producers to obtain their opinion as to whether or not they will fulfill their needs. The cooperation of the National Crushed Stone Association and the National Slag Association has been solicited in this further work.

In addition to standardization of wire diameters, information is also being collected relative to the feasibility of effecting standardization in width of wire screens. In this study the cooperation of manufacturers of screening equipment, other than the wire screen itself, has been obtained.

Tests for Member Companies

As has been pointed out, the study of special problems for member companies has accounted for a larger share of the activities of our laboratory during this year than in the past. The carrying out of accelerated soundness tests on a large number of sands has represented an important part of our work. Two other sand investigations which required the making and testing of a large number of mortar and concrete specimens have been mentioned. Many other tests of somewhat less general interest have been carried out. In general, the use of the research laboratory for these special problems cannot be completely justified unless they yield information of a fundamental nature. This has been the case for practically all of the special investigations which have been made. They have been helpful not only in furnishing information of general interest but in pointing to problems which need further study.

Research Problems

The research work which has been carried out by the Association, and, for that matter, by other organizations, hardly scratches the surface of the problems on which work should be done. Research should lead to the more intelligent use of the products of the industry, expand present markets for them, and develop new ones. The work carried out to date has been pointed particularly to the more intelligent and economical use of sand and gravel and much remains to be done.

In the field of concrete, the studies of grading of aggregate will not be completed until a satisfactory and scientific method of proportioning concrete has been developed. It is only when such a method has been devised and accepted by the consumer that we can look forward to the most economical use of sand and gravel. The studies of the effects of aggregate characteristics cannot be drawn to a final conclusion until fundamental principles, showing what characteristics affect the strength and the reason for these effects, have been determined. Investigations of sands have been barely touched. Work that has been done leads to the belief that the quality of sands exerts a very much more important effect on the quality of the concrete than does the quality of the coarse aggregate. Durability of concrete has only recently been given the attention which it deserves. The part played by the quality of the aggregates in determining the durability of concrete is a most important economic problem of the industry, as certain members of the Association can attest from personal experience.

Conclusions

The above brief summary mentions only a few of the more important problems which are involved in the use of aggregates in concrete. Many more might be mentioned. Further data on fire-resisting properties of the different types of materials are needed. Studies of the volume changes of the concrete as affected by the type and grading of the aggregate would yield information of great value to the industry. The effects of various deleterious substances in aggregates on the quality of concrete need study, if more intelligent and economically sound specifications are to be written. Studies of methods for preventing segregation are of great importance in connection with the limitations of grading specifications.

In the field of ballast much can be done to expand present markets. This is clearly demonstrated from the industry's past experience of the beneficial results which have come from the development of the specification for grading of ballast six years ago through the cooperation of the Association's washed gravel ballast committee and the ballast committee of the American Railway Engineering Association. Studies to develop suitable tests to measure the quality of ballast should be carried to a point where they will yield information of practical value. Investigations of such factors as stability will do much to show what gradings may be used to the greatest advantage.

The field of bituminous construction offers one of the greatest opportunities available for the expansion of markets. Gravel has been used to a considerable extent in this type of construction, but there has not been a sufficiently general recognition of the economy resulting from its use or sufficient knowledge developed as to the best methods of using it. The attention which has been paid in recent years to the construction of the so-called "low-cost" road indicates a field for marketing prepared sand and gravel, the development of which can undoubtedly be assisted by properly directed researches. Numerous problems in the field of water and sewage filtration, foundry sands, abrasion sands, etc., present themselves.

Advantage should be taken of this opportunity to express our appreciation for the cooperation which has been received from the Association membership during this period of lessened business activities. It has been realized by the membership that the results of research are permanent and that progress in it must be continuous if worthwhile results are to be obtained. It is true that our laboratory has operated under a somewhat reduced budget this year, but nevertheless, the continuity of the work has not been broken. The many problems on which work should be done have been barely mentioned in the preceding. It is confidently expected that our investigations will be continued with increased facilities during the coming years. Much of tangible value to the industry has already been accomplished; with the foundation which has been established, further work should be more effective than that carried out in the past.

Design and Control of Concrete Mixtures

THE FOURTH EDITION, 1931, of "The Design and Control of Concrete Mixtures," published by the Portland Cement Association, contains the same number of pages as the third edition, 1929, and the greater part of the text is the same, word for word. But there are some very important changes in the part that is not reproduced verbatim, especially in the first ten pages. These reflect the present trend of thought which has come from so much investigation in the field and in the laboratory of the durability of concrete and of concrete aggregates. Emphasis is placed on the importance of durability rather than strength in the foreword and in the pages discussing the design of concrete mixtures for definite requirements.

It is stated that a condition has been brought about by the introduction of high early strength cements and the general increase of strength in portland cements "whereby the usual strength factors can be obtained with quantities of cement which are unsatisfactory from the standpoint of durability and workability." Hence design today should be in accordance with the exposure the concrete must meet rather than the strength required, for if the conditions for exposure are met the strength will be ample.

The table of water-cement ratios in the third edition has been enlarged and modified in the fourth edition. Instead of one water-cement ratio for each of the three classes of structures described, there are four, based on the degree of exposure to water and to weather conditions. These are for definite minimum curing conditions, and for less favorable conditions it is recommended that lower water-cement ratios should be used. Most of the recommended water-cement ratios are 5½ and 6 gal. per sack of cement.

The trial method of design is recommended as it is practical, easy to apply, and gives the desired results.

Review of Agricultural Limestone Situation in Midwest States, 1931

By J. R. Bent
Illinois Agricultural Association, Chicago, Ill.

IN PASSING in review the conditions and developments related to the production and use of agricultural limestone during the year 1931, the writer has endeavored to include, as one district, all those states known as the Midwest, or grain producing states, but in doing so has covered, in more detail, facts and conditions experienced in Illinois. This is not so much because Illinois is a heavier user of agricultural limestone than any other state, as it is due to the fact that Illinois is the state in which the writer's own activities bring him in closer contact with the situation. Most of the important factors affecting the production and use of agricultural limestone in Illinois contribute in more or less degree to the situation in each of the other states as well. This is especially true as regards the general depression which has been felt by both agriculture and the quarry industry without much distinction as to state or distsrict.

In preparing a similar review a year ago the writer commented upon the effect of the financial depression which the country was feeling at that time and upon the effect of the severe drought which the Midwest had experienced during the summer of 1930. A hope was expressed that if financial conditions should be well on the road to recovery by the summer of 1931, and if weather conditions were normal, there would be a return to a normal demand for agricultural limestone by the farmers. Bad as the financial situation was during the summer of 1930, it became much worse during the summer of 1931. During the spring of 1931 the demand for agricultural limestone, as compared with the same period in previous years, was fairly satisfactory, but by mid-summer the condition of the rural banks had become so critical, and ready money had become so scarce, that a large proportion of the farmers who desired to use agricultural limestone found it impossible to raise the necessary funds and, as a result, the volume of business, as compared with the more recent previous years, dropped off heavily. The 1931 weather conditions were favorable throughout much of the Midwest, but in areas that suffered from the drought during the summer of 1930 many fields which had been limed and seeded to clovers burned out that year. These same fields were reseeded in 1931 without the necessity of reliming, thus eliminating additional fields which otherwise would have been limed in 1931 and seeded to cover.

At the time of writing this review, accurate tonnage figures are not available for any of the states and in several cases even estimates are made with insufficient information, but it seems probable that Illinois in 1931 will show only an aggregate tonnage of about 40% of that used in 1930 or between 30 and 35% of that used in 1929; Illinois can be taken as typical of the average of the Midwest in this respect. (The opinion of an authority in each of the states involved will be found quoted at the end of this review.)

Price Level Had Little To Do With Demand

A large part of the agricultural limestone produced by the quarries in the Midwest is either a byproduct or a coproduct of other sizes of crushed stone used for highway construction, concrete, railroad ballast, steel flux and chemical industries. Production of agricultural limestone, therefore, rises and falls in tonnage with activities along these other lines and is not governed to fit the demand from the farmers. Despite the reduced outlet for limestone in the other directions mentioned, carrying with it a reduced production of agricultural limestone, the supply of the latter was more than adequate to meet the demand this season. This situation has had a very marked influence upon price levels. Quarry operators, instead of being able to reduce their storage piles during July, August and September, the months when normally the greatest demand for agricultural limestone develops, have seen these piles, in many cases, actually grow in size.

With low prices prevailing for concrete aggregate and other sizes of stone, operators have been tempted, and in some cases have experienced a positive need, to reduce their inventories and so liquidate on the storage material, even at a loss compared with the cost of production. Agricultural limestone, therefore, has not been an exception to the rule of falling commodity prices. In some districts price reductions were less and in some more, but the extent of the price reductions seem to have had little bearing upon the extent to which farmers bought. The real inhibiting factor seems to have been a lack of ready money or the inability on the part of the farmer to get the funds necessary for purchasing.

Quality Maintained

Any situation, such as that just described, might lead, in time, to carelessness in the production of agricultural limestone and a letting down of the quality standard, but this season such was not the case. The hold-over supply from production earlier in the year; the mechanical changes and improvements which had previously been made at the various cleaning and sizing plants; the competitive sales situation; and last, but not least, the effect of the rapidly developing recognition on the part of both the producers and the users of agricultural limestone, of the importance of quality, have served to hold the progress that has been made in recent years, and in some cases to register new steps forward.

Earlier in the history of the agricultural limestone project the Midwest products for the most part consisted of relatively coarse and frequently low grade (dirty) byproduct screenings. Gradually standards have been raised until today the product consists partly of directly pulverized clean stone and largely of byproduct secondary screenings (in many cases the primary screenings containing the dirt from the quarry have been eliminated by the first or scalping screen and have been disposed of for other purposes). The size of the mesh or perforation through which the byproduct material is now passed has been reduced in most cases, although there is still a wide range in products of various companies and quarries attempting to compete with each other.

Some producers have installed reduction machinery through which they are running surplus material of larger market sizes. As a matter of economical operation this material is not reduced to 100% agricultural fineness; instead it is partly reduced and then returned to the sizing sscreen, thus incidentally increasing the volume and improving the quality of the byproduct agricultural screenings.

Much of the agricultural stone now being produced is the product of vibrating screens which make possible a much finer mesh or size of opening than would have been permissible in the old revolving screens in connection with the production of clean concrete aggregate.

One of the problems which confronts the quarry operator today seems to be the disposition on a profitable basis of the size of stone frequently referred to as "chips," which occupy the zone between the maximum size satisfactory or desirable for agricultural limestone, and the minimum size permissible in concrete aggregate. This problem carries with it a temptation to many

quarry operators to consider the agricultural grade as everything which will pass a ¼-in. opening. A few quarry operators continue to think of agricultural stone as a low grade, semi-waste product, but this is a bad mistake.

Farmers' Gain at Present Prices

Authorities at agricultural experiment stations have estimated the economic value of agricultural limestone, when used on soils which need liming, even on the basis of present low market prices of grains and other farm crops, as ranging from $4 to $9 per ton (in some cases more). With agricultural limestone costing the farmer, freight included, from $1.50 to $2.25 per ton, it should be evident that a 10% improvement in the quality of the product, either as regards its chemical purity or its physical fineness, is much more important and represents more in money terms than a 10% reduction in its market price. Quarry operators should look upon agricultural limestone as a major product of their industry upon which they will depend more and more in the future, and should assist in every way possible to arrive at that grade of material, especially as to physical fineness, which will produce the greatest returns when used on the soil, for each dollar of production cost at the quarry.

In the past, agricultural authorities in the eastern states have laid much stress upon the importance of screen fineness, from the standpoint of early availability in the soil. As a result the eastern farmer has come to consider anything but finely ground limestone as being virtually worthless. Quarry operators in order to meet this situation have been obliged to charge much higher prices for a directly ground, very fine product. Because of the higher price farmers have been tempted to forego the use of limestone wherever possible and to use it in relatively small amounts when they do buy. Somewhere between the two extremes it should be possible to find the most economic product, cost of production and results in the soil both considered.

It is the writer's opinion that under present conditions in Illinois and similar territory there should be a maximum size not to exceed 3/16 in. or approximately 4-mesh, and, wherever it is possible, without too great a sacrifice or expense, the maximum might better be set at not to exceed ⅛ in.

Still Doubt As To Fineness

No hard or fast rule can be laid down for screen fineness applicable to all cases and districts. Limestone differs in chemical and physical characteristics. The relatively soft and the less crystalline types of high calcium stone are much more soluble in the soil than are the dense and crystalline types of high calcium stone. The porous and semi-disintegrated types of dolomitic stones are more soluble in the soil than are the dense, true dolomites, such as the Niagara in the Chicago area. Again the high calcium types of stone are more active, though having less total neutralizing strength, than equally pure and equally dense dolomites. It follows that it is more important for the dolomites and the denser stones to be finely ground and screened than it is for the softer stones and those of the calcium type. In practice the reverse is too often the case. Perhaps this situation is partly due to the fact that the dense tough stones do not shatter as readily and produce as high a percentage of "fines" in the byproduct screenings as do the soft and brittle types of stones. These considerations become of especial importance when the two types come in direct competition in the same market area.

The guiding consideration precedent to determining how fine an agricultural limestone product should be is the promptness of the response or availability in the soil which the user feels he must have, or at least desires, and is willing to pay for. The finer the product is, the quicker will be the results in the soil; conversely the coarser the material the slower and more extended, as to time, will be the results.

If neither cost of product at the quarry, or extended results in the soil are considered, limestone can be ground to such a fine degree that it will all become available in the soil in a period of days, providing there is a reasonable amount of moisture and sufficient acidity present, or it can be ground to a degree or fineness under which, say, 75% of it would react in the soil within a period of a year under similar soil conditions.

Again, the material could have so much excessive coarse particles, and so little of the so-called "fines," that the response in the soil would be so delayed and slow it would not even keep up with the current development of soil acidity. It is important, therefore, the material shall be fine enough so that when used in sufficient quantity and given thorough distribution in the soil, the diffusion of neutralized soil solutions, which radiates from each limestone particle as an active center, will permeate the entire body of the soil in the tillable layer.

In the grain farming district, as a rule, whatever physical grade of limestone is used, it should be used in large enough amounts per acre to furnish a sufficient quantity of the 48-mesh and finer material, which it carries, to neutralize the existing acidity within the first six months, under normal weather and moisture conditions.

From an economic standpoint the first consideration should be, "Will a larger amount of a relatively coarser material furnish the required volume of fines to give the desired promptness of response at a less cost per acre, distributed on the soil, than will a finer, but more expensive, product used in a smaller, but nevertheless sufficient, amount per acre to accomplish the same end?" If, when thus compared, the choice is about equally balanced, the somewhat coarser material has an advantage in that it furnishes a supply of particles, graduating upward in size, and which would constitute what might be termed a "maintenance ration," steadily supplying, throughout an extended period a neutralizing influence against the further development of acidity.

Why Illinois Prefers Relatively Coarse Product

There are, of course, limits beyond which response from the increasingly larger particles is so slow that it will not support the cost of application; wiping out progressively; first, the quarry price, then the freight rate, then the unloading and distributing labor costs. It is probable that, even under favorable conditions, material ¼-in. or larger in size is virtually worthless. However, under certain conditions it may be more economic in the end to include in the finished product material which ranges from 8-mesh to 4-mesh in size than it is to go to the expense of eliminating it. This is a consideration which will differ in the different states and districts and will vary in keeping with such factors as difference in soil type; moisture and weather conditions; farming systems; the physical and chemical type of limestone itself; freight rates; and last, but not least, the disposition the quarry operator can make of the next larger size material. The problem is a complex one, but down to the present time it has not been given as much thought and constructive study as its importance warrants.

In Illinois the theory has been that the so-called screenings which *are* a byproduct of the crushed stone industry can be sold to and used by the farmers at a price which is more economical for the results achieved than can the so-called finely ground limestone. However, this theory has been abused by some producers in the past who have attempted to market material worthlessly coarse. There is today a tendency to pay more attention to the matter of screen fineness, and the average product in this respect has been steadily improving.

There is great need for some recognized and uniform unit of measurement for weighing the useful value of agricultural limestone products of various degrees of fineness. Obviously an arbitrary time factor for the response in the soil must be assumed in order to establish such a unit.

At present widely varying units are used in which the time factors differ greatly. As an example, studies by the Illinois Agricultural Experiment Station lead to a conclusion that the average or representative byproduct screenings being produced and used in that state develop an availability during a three to five year normal crop rotation period (the time factor assumed in this case) of about 80% in terms of calcium carbonate equivalent (or about 44 to 45% calcium oxide). As against this the National Lime Association bases its appraisal upon an assumption that immediate availability, such as is achieved with lime in the oxide and

hydroxide forms, should be the standard, and the association has published a chart showing the amount of liming materials used in various states converted to what it terms "effective lime oxides," which it has computed on the basis of 35% for limestone screenings and farm-dug marl; 50% for ground limestone, miscellaneous materials and commercial marl; 70% for hydrated lime and 85% for burned or quicklime.

It should be evident that the word "available" and the word "effective," as used in this connection, need further definition in the light of the time factor, otherwise they can lead to widely different results, depending upon the individual viewpoints.

More Accurate Definitions Desirable

Here is another example of how definitions can differ officially as well as scientifically: The state of Ohio has established a law which arbitrarily classifies agricultural limestone products as follows: "Agricultural Limestone Screenings" as material 100% of which will pass a 3-mesh sieve; "Agricultural Limestone Meal" as material 20% of which passes a 100-mesh sieve, 30% passes a 50-mesh, 80% passes a 10-mesh and 100% passes a 4-mesh; "Agricultural Ground Limestone" is defined as material 30% of which will pass a 100-mesh sieve; 50% pass a 50-mesh sieve and 95% pass a 10-mesh sieve. On the other hand the Association of Official Agricultural Chemists at its recent meeting in Washington, D. C. (November 2 to 4, 1931), endorsed the report of its committee on definitions in which was included the following definition for ground limestone: "The product obtained by grinding calcareous or dolomitic limestone. Not less than 75% should pass a 100-mesh sieve, and should contain calcium and magnesium carbonates equivalent to not less than 90% calcium carbonate."

Perhaps the Association of Official Agricultural Chemists, in establishing this definition, had in mind primarily ground limestone for use as a filler or conditioner in the manufacture of commercial fertilizer. A fineness to the extent of 75% through 100-mesh is doubtless justified for such use, but it is unfortunate that there should be two official and legally recognized definitions, each using the words "Ground Limestone," one of which requires 75% to pass a 100-mesh and the other of which requires 30% to pass a 100-mesh. Under such lack of uniformity the using farmer is easily confused and a handicap is placed in the way of those who are endeavoring to promote much greater and more general use of limestone on the soil.

Quarry operators should take an active hand and cooperate with agricultural research authorities and representatives of farm organizations in finding a satisfactory answer to the probems of commercial screen standards and optimum fineness of grinding best fitting the various districts.

More Uniformity in Quality Desirable

Lack of uniformity in standards is not limited to a comparison of one district with another nor even to a comparison of the product of one quarry with that of another. There are individual plants in which a variation is found from time to time. Some quarry operations are conducted in two or more beds or levels of limestone, which differ from each other in character; also screens are changed from time to time in an attempt to better meet some change in market conditions and requirements involving other sizes of stone. In all such cases if the agricultural stone consists of byproduct screenings, it is sure to vary in character and quality. At some of the larger plants the flow of stone from the primary crusher to the finished bins is split and passes through parallel screening systems which are not always alike. The byproduct screenings from these subplants will differ and if shipments are made interchangeably from the different bins, or the end products are combined in variable proportions in one bin, there can be no dependably uniform grade of material upon which reputation and maximum sales can be successfully built.

Another feature which is more or less confusing to the farmer and at times leads to misunderstanding, even within the industry and among agricultural authorities, is the distinction between "screen mesh" and "screen net opening." For instance, 8-mesh material and ⅛-in. material are thought by many to be the same thing, which, of course, they are not.

A variety in the color of the various products continues to be more or less a trouble maker, though it does not necessarily have any significance in and of itself. Gradually farm advisers, dealers and farmers themselves are coming to understand that limestones may differ greatly in color without differing in essential chemical quality. Education along this line should be continued by quarry operators and by agricultural authorities so that farmers who have been accustomed to buying limestone of a certain color will not think they are getting an inferior product if a shipment from some other source is of a different color, particularly if it should be darker.

Sampling

No uniform and scientific system of sampling has been established and it is not only possible but probable that samples taken from carloads or from storage piles by any ordinary method can vary greatly and fail to be representative of the average run of the material. This is especially true in the case of the coarser grades of agricultural limestone and is due to the fact that, as the material falls into a bin or cars, or is unloaded on a pile, there is a natural segregation of particle sizes; the coarser particles avalanche to the lower or outer portion of the pile and the fine material remains in the center. Experience and great care are necessary in the sampling of storage piles of any considerable volume. It is much easier and more accurate to sample the average run of a plant by catching, at intervals and then combining, samples from the entire stream as it comes from the sizing screen. Even under such a method results will vary with the weather and the percentage of moisture which is in the stone as it comes from the quarry.

There is not so much danger of discrepancies in the laboratory work. Informed and experienced chemists will secure concordant results when working on portions from the same sample. This is true both as to the screen tests and the chemical tests. The Association of Official Agricultural Chemists has established a definite laboratory method for determining neutralizing value in terms of calcium carbonate equivalent. The Illinois Agricultural Association, which the writer represents, in agreement with the Agricultural Experiment Station, University of Illinois, has adopted a system for Illinois which differs from the A.O.A.C. method in unimportant details, but corresponds to the latter in all essential features. A mimeographed copy of the Illinois method will be furnished by the writer to any interested party who may request it.

Market Peculiarities

The season in which the farmer uses agricultural limestone depends upon the type of farming. In most districts the use of limestone has always been a highly concentrated seasonal matter. The rapid development of better farm to market roads has greatly lessened the danger of bad hauling conditions due to unfavorable weather, and this is having a tendency to spread out the limestone shipping period by making it possible for the farmer to receive and unload his shipment at times when his farm work will permit, even if he does not make immediate distribution on his fields.

The fact that 65 to 75% of agricultural limestone shipments are usually made within a period of three months, although the production thereof covers a period of six to ten months, necessitates extensive storage provisions at the quarry. The cost of unloading to storage piles and recovering for subsequent shipment is a very considerable item when compared with the net sales price of the product. Quarry operators are ever on the alert to hold this factor to the minimum. In many cases greater care in the preparation of the storage space and subsequent protection of the storage pile against contamination from dirt, waste material and stone of coarser sizes, and the adoption of storage handling methods which will minimize the amount of segregation of the coarser particles in the pile, should help greatly in holding down the average per ton cost of such storage and reclamation by eliminating the expensive waste of some of the material which carelessness in these respects is sure to cause.

Motor Truck Deliveries From Quarry to Farm

Motor truck deliveries direct from the quarries to the farm are becoming more and more a factor. This is particularly true in the case of quarries located adjacent to large market and business centers. The radius served by truck owners who make use of agricultural limestone as a means of revenue when returning, otherwise empty, from such market centers, is becoming greater each year. This is a valuable service which should not be discounted, but it carries with it the disadvantage of preventing the contact which is desirable between the agricultural limestone producer and his ultimate customer, the using farmer.

Hand in hand with the development of cooperative marketing of farm products there has been a development of cooperative purchasing of farm supplies. As yet this has not extended very greatly into the realm of agricultural limestone. Probably the nearest approach to it has been the relationship which has been in effect, throughout a number of years past, between the quarry operators serving the needs of Illinois and the Illinois Agricultural Association which the writer represents, but this work has been more in the nature of quality supervision and price bargaining than it has been in direct purchasing and billing. It seems probable, however, that in the future agricultural limestone will become more and more a commodity handled by farm cooperatives.

Whether or not limestone is sold by the producer directly to using farmers, or through retail dealers or through farm cooperatives, it is, and always will be true that it is not a commodity which sells itself. Although the day has gone by when a majority of the farmers were skeptical about the value of agricultural limestone as a soil builder; and the majority of farmers today are more or less convinced that it is valuable: still, it must compete with other uses for the farmer's dollar which uses are much more of a direct temptation to him. Aggressive sales efforts, therefore, are necessary, though they should be conducted on the most economical basis which will accomplish the end, because of the relatively low price of the commodity being sold.

Local Portable Grinders

The local portable grinding plant continues to be a very material factor in the picture. Even under the price conditions which prevailed during the 1931 season, many local plants operated and supplied their respective communities. As a rule, however, such plants cannot compete successfully in districts which can be reached from commercial quarries with a favorable freight rate and where the distance from railroad station to the various farms is not too great or difficult. It is not uncommon in states and districts where the limestone project is relatively new, for farmers and their advisers to consider that the existence of a local limestone deposit in the community is the only important consideration, and then to discover otherwise after money has been invested in the purchase of a portable hammer pulverizer and power machinery. Needless to say, the larger part of the cost of producing agricultural limestone with such plants lies in the labor and power required and in the initial and upkeep costs of the equipment necessary, and not the deposit value of the limestone itself.

Drilling Limestone With Seed

A year ago in reviewing the agricultural limestone situation the writer mentioned recent experiments by William A. Albrecht and E. M. Poirot of the Missouri Agricultural Experiment Station, on the use of 200-mesh limestone drilled in the row with legume seed. Interest in the result of this experiment has continued to increase, but the amount of expensive material that has been used in this way is still exceedingly small in comparison with the amount of limestone of standard agricultural grade which has been used by the broadcasting in heavier amounts per acre. The writer feels that these two widely differing products and methods of use should not be confused or even considered competitive, but that each has its own distinct objective and field of service.

Apparently the light applications of fine material by drilling in with the seed is comparable to similar use of hydrate lime and is valuable in cases where immediate results are essential and where a good start for the seedling is important in soils that are mildly acid in the top layer but have a satisfactory supply of calcium and a sweet condition in the lower layers. It would seem that the old method of heavier broadcast applications will continue to be the prevailing one, especially where soil building and conditioning and the welfare of succeeding crops are the prime considerations.

Comparison of Magnesium and High Calcium Limestones

Recently investigations have been undertaken by some of the State Experiment Stations in order to determine whether or not the magnesium types of limestone have any advantage in comparison with the calcium types in the influence which each may have upon the availability of the forms of phosphorus in the soil. While some of these experiments have seemed to suggest that magnesium deficiency in the soil has a relation to lack of availability of phosphorus, still, no conclusive results have been achieved as yet. This is a feature which may become of major interest to producers and users of agricultural limestone, especially in districts where the dolomites or magnesium types are competing with the so-called high calcium types. These experiments will be watched with much interest for that reason.

Credit What Farmer Needs Most

Turning again to a consideration of the economic situation, which at present is the greatest obstacle to a much larger use of limestone on the soil, the writer feels that nothing could help so much as the finding of some satisfactory basis for credit extension to the farmer who has occasion and desire to buy and use limestone. Under normal conditions funds are available by means of real estate mortgages for the purchase of lands and the construction of buildings, and short-time loans are available through liens on the growing crop to take care of the season's operating expense; but there seems to be no way in which a farmer can borrow money to buy limestone, on its own security, and spread the repayment over the period of time in which the benefits are experienced.

Many country bankers have come to realize there are few investments which the farmer can make with greater profit or economic return than the purchase of agricultural limestone, and in normal times have made loans to reputable farmers for this purpose, but beyond the farmer's good name and promise to pay, such loans are usually without security. Under the existing condition of the average rural bank the money is not available, regardless of security or the farmer's moral responsibility. To offset this difficulty, many quarry operators have tried to encourage the farmer to purchase limestone by consenting to extend the payment date.

If some form of credit organization could be devised and established and put into a position to make loans for a period of one, two or three years, on some sound business basis, for the purpose of enabling the farmer to purchase limestone, an inestimable amount of good would result.

Type of Farming Influences Changed Demand

A careful analysis showing which of the states and districts have suffered the most and which have suffered the least, in the volume of agricultural limestone used in 1931, seems to indicate that the type of farmer has had some influence. Wisconsin, for instance, seems to be the one Midwest state in which the volume of agricultural limestone increased slightly in 1931 compared with 1930. It is probable that this is due in no small measure to the fact that Wisconsin is a dairy state, and dairy farming, while not prosperous, has perhaps suffered less than grain farming under the present financial depression. Another influence that has contributed, is the fact that the limestone project is relatively new in Wisconsin and has not as yet developed to large proportions, although the fact that it is a dairying state, and therefore must depend upon a relatively large acreage of alfalfa and clover, makes a sweet soil of high calcium content essential.

More and more attention is being directed toward the need for an intelligent and well coordinated national land utilization policy. This is the natural result of the much discussed problem of surplus agricultural production. Agricultural limestone has a very important part to play in the consideration

of all such matters. Losses through leaching and erosion are much greater in cultivated soils than in soils that are in permanent grass or forest. The soils which are showing the greatest need for lime treatment are those which most easily fall prey to erosion. Many of these areas should be restored to permanent grass and timber. In the case of the grazing lands, this can best be accomplished by the use of legumes, which in turn require a pre-treatment of limestone. Losses of calcium through cropping methods are apt to be greater in the future than they have been in the past, if, as seems likely, straw, corn stalks and other farm roughage, hitherto returned to the soil, in the future find market outlets in manufactured products. A large part of the "ash" of this roughage is calcium.

Several factors will have a vital bearing upon the limestone project in 1932; some of these are, first, conditions of rural credits and the ability of rural banks to loan money to limestone purchasing farmers; second, prices of farm products, particularly grains; third, weather conditions; fourth, prices of agricultural limestone in relation to quality; fifth, the degree of aggressiveness and effectiveness put into sales efforts.

Conditions in Various States

The writer makes grateful acknowledgement to authorities in other Midwest states who have kindly furnished details covering the agricultural limestone projects in their respective states, as follows:

MICHIGAN—George M. Grantham, associate professor in soils, Michigan State College, says that under present conditions a large number of the farmers in Michigan have turned to the use of marl because of the cheapness of that material. As a result the amount of marl used this year in Michigan shows an increase over last year; whereas, limestone has shown a decrease. Professor Grantham thinks that the limestone used in 1931 will approximate two-thirds of the amount used in 1930. The price level of limestone has changed very little, although there is a slight decrease in the coarser grades. There has been little change in the character of the limestone used. He thinks that 1932 will see further decrease in the volume of limestone unless conditions take a turn for the better. In commenting upon the use of marl, Professor Grantham says that fortunately the soils which are in need of lime are frequently in locations where marl is found in greatest abundance. The Lacrustine soils of the eastern part of Michigan are, for the most part, sweet. In this part of the state marl deposits are rather scarce. The purity of the marl is variable; some of the deposits have a low neutralizing value, whereas others approach the strength of limestone. The majority will average about 80% calcium carbonate equivalent, or better. Almost without exception marl is being used [illegible] to its origin and transportation is by truck or wagon; rarely, if ever, is it shipped by rail. The cost of marl varies considerably. It sells at from 10c to 40c per load *in the deposit*, or 50c per load after being dug out and piled up to dry.

Farmers spread marl by means of the ordinary manure spreader, with or without the lime-spreading attachment. This helps to pulverize the material as it is being spread. Because of the fact that the quality of marl varies greatly and cannot be determined by appearance (some materials resemble marl which are not marl at all), it is very important that a deposit be tested by some competent authority before its use is undertaken. In Michigan the State College undertakes to do this without charge. Because of the inferior value and physical condition of marl, a larger amount is used per acre than is necessary in the case of limestone.

OHIO—Robert M. Salter, chairman, Department of Soils, Ohio State College of Agriculture, estimates (although he says that he has no definite figures upon which to base his opinion) that the tonnage of liming material consumed in Ohio in 1931 is approximately 60 to 70% of the 1930 tonnage. He says "there has been rather intense competition, resulting in a large amount of price cutting and a wide range of prices for a given grade, in different sections of the state. In general, prices have been reduced from 10 to 20%." He expresses the opinion that there has not been much change in the relative proportions of the different types of materials used. He also expresses the feeling that the prospect for 1932 is anything but promising unless conditions take a decided turn for the better.

INDIANA—K. E. Beeson, extension agronomist, Purdue University, LaFayette, Ind., says: "As yet we have not collected the report on the distribution of limestone and marl from either county agents or distributors. I can only guess at the reduction in sales, and suppose it is somewhere around 50% of last year.

"The general price level is slightly lower. There has been a larger quantity of finely ground material, delivered in bags, used in Indiana this year than ever before. One county used 18 cars last spring, and many used at least one car. There will doubtless be a marked increase in the amount used this way next year. The increase in the use of this material will probably modify the general use of ground limestone to some extent next season."

WISCONSIN—E. Truog, professor of soils, Wisconsin State College of Agriculture, says that there will probably be a slight increase in the use of lime for agricultural purposes in 1931 as compared with 1930. Some of the material has been produced by local plants of the portable and semi-portable type, and the sales price on this material has been reduced 25% as compared with the previous year. The price of limestone sold by the commercial shipping quarries, however, has not changed very much and the character of the material has remained about the same. He says that "in spite of the depression farmers are showing an unusual interest in the use of liming materials, and there appears to be a good prospect that an increased tonnage will be used next year." He accounts for this partly by the fact that Wisconsin is a dairy state and has not been hit by the depression as much as some of the neighboring states. He says it also is partly due to the fact that liming is relatively newer in Wisconsin and has not been practiced to as great an extent as in Illinois. In certain portions of the state, inability in recent years to get catches of clover and alfalfa has forced many farmers to give consideration to the matter of liming.

IOWA—P. E. Brown, acting head of the Farm Crops and Soils Department, Iowa State College, estimates that this year Iowa farmers will not use more than 50% as much agricultural limestone as they did in 1930. He says there has been no change in the general price level and no change in the character of the material used. He wishes it understood that his estimate is based upon general observation and not upon definite figures, which as yet are not available, though they will be a little later. He thinks that if there is some improvement in the general farm situation prior to the opening of 1932 spring season, Iowa will use as large a volume of agricultural limestone as it has this year; perhaps even larger; but if conditions do not improve by spring, it is very doubtful if there will be as much in 1932 as there was this year. In other words, everything depends upon the development of the agricultural situation.

Describing in more detail the areas in Iowa which are using limestone, and the sources of material, Professor Brown says, "That the limestone project or projects which are being sponsored in Iowa by the Agricultural Extension Service and the State College are developed in all parts of the state, but there is naturally much greater interest attached to the lime problem in the southern, eastern and north central portions of the state, where the soils are practically all acid. In the western section and in the northwestern central portions there is not so much interest in lime, although it is becoming more and more significant there, too, inasmuch as farmers are finding that the surface soils are slightly acid, and when they wish to grow sweet clover or alfalfa, especially, small amounts of lime to neutralize the surface soil acidity are very desirable.

"Sources of supply of limestone in the state are not well distributed. Most of the sources are found in the northeastern and southeastern parts of the state. Unfortunately, there are not readily available sources for most of southern Iowa except the extremely southeastern portions. In the far western part of the state there is a source in Nebraska which is available. The long hauls and large freight rates in many sections of the state have been the chief factor limiting the utilization of lime for agricultural purposes in many parts of the state.

"The greater part of the material used in the state is limestone screenings or the by-product from the crushed stone industries. Most of the companies, however, are making an attempt to furnish material which is fine, to meet the requirements which seem most desirable for the best results on soils."

MISSOURI—O. T. Coleman, extension assistant, professor of soils, Missouri State College of Agriculture, says that Missouri will use in 1931 around 35% as much agricultural limestone as it did in 1930. He says the general price level has declined somewhat, especially where there has been some competition, but that there has not been much change in the general character of the material used. He feels that the prospects for next season are not any too encouraging. Farmers who have available cash will doubtless use limestone, but the average farmer is not likely to be in a position to buy this material.

KENTUCKY—S. C. Jones, field agent in soils, Kentucky College of Agriculture, feels that there will be a reduction of from 20 to 30% in the amount of lime material used in 1931 as compared with 1930. He says there has been a slight lowering in the price of these materials, but very little change in their character. He says that a new source of supply has been developing in the form of byproduct material from the State Road Department which in some cases is being sold at very low prices, and that this may develop to a much greater extent in the future. He expects that the quality of this material will improve through experience in its production and marketing. What the year 1932 has in store in the way of amount of agricultural limestone used will depend, to a large extent, upon the price the Kentucky tobacco crop brings. Lack of money is the main reason for the reduction in tonnage this year, and that is apt to be true again in 1932.

KANSAS—From E. B. Wells, secretary of the Kansas Crop Improvement Association, Manhattan, Kan., comes the report that the tonnage of agricultural limestone used in Kansas in 1931 has dropped off about 40% as compared with 1930 and about 50% as compared with 1929. He attributes this to the fact that the limestone-using section of Kansas has experienced two excessively dry seasons which have made it almost impossible to prepare land for alfalfa. The price of limestone has dropped about 20 to 25%, but the quality has been maintained, with the exception of only one or two sources of supply where the producers "are a little bit careless regarding quality." He feels that there is a prospect of some increase in the use of agricultural limestone in 1932, although he does not anticipate any great change. A grade of limestone, which is used to a considerable extent in Kansas, seems to be minus 10-mesh material, for which the producers are charging prices which have ranged from $1 to $1.50 per ton. The following tabulation shows the tonnages of the limestone used in Kansas during the five-year period 1926-1930, inclusive:

Year	Tons
1926	23,647
1927	28,829
1928	42,587
1929	43,353
1930	34,844

Ground Rock Phosphate (Lime Phosphate)

In previous years the writer has attempted to cover ground rock phosphate as well as agricultural limestone in this review. This year no attempt will be made to do so, other than to say that the economic conditions which have surrounded both supply and demand in agricultural limestone are for the most part equally applicable to ground rock phosphate. It is of interest to note, however, that in Illinois at least, and presumably in other Midwest states as well, ground rock phosphate ("lime phosphate") has maintained approximately the same ratio as agricultural limestone for 1931 as compared to 1930.

It would be natural to assume that the phosphate product, being so much more expensive per ton than the limestone, would suffer much more under the present financial depression; that it did not, can be accounted for partly by the trained selling that was put behind the rock phosphate, but in the writer's opinion there is a significant moral—the rock phosphate using farmer is essentially a farmer who is thinking in terms of the future and is building today for a future prosperity. He is a man who has a definite program, to which he adheres through good times and bad; generally speaking he is better able to weather hard times and to make money in good times.

Finely ground natural rock phosphate, when properly used on soils of the types which need phosphorus and respond to its use, continues to prove itself one of the best investments a farmer can make. In the past too much stress has been laid upon one of its virtues to the neglect of the others; namely, its ability to increase yields. Perhaps as important, if not more important, is the effect which it has upon a vigorous start for the crop, enabling the latter to get quickly by the pests and dangers which threaten its earlier life and then again, at ripening time the effect upon hastening maturity, which frequently means the difference between success and failure if early frosts are encountered.

Ordinance Authorizing Sale of Sand and Gravel by Weight Approved

THE Minneapolis, Minn., city council committee on ordinances and legislation has recommended adoption of an ordinance calling for sale of all crushed rock, sand, and gravel in Minneapolis by weight instead of volume on and after May 1, 1932.—*Minneapolis* (Minn.) *Tribune.*

Opens Rock Crushing Plant in North Carolina

A COMPANY has been organized at Fletcher, to be known as the Fletcher Lime-Stone Co. The product to be put on the market by the company at the present is crushed stone, and later it will burn lime. The machinery for crushing the stone is being installed and work was to start about January 1. About 20 men will be employed.

The site of the plant is about one mile from Fletcher at the old lime kiln which was operated by H. E. Lance. It has been about 25 years since this kiln was operated. Prior to that time lime had been burned there for years by Mr. Lance and by his father, the late N. J. Lance.

The members of the company are all local men. They are W. N. Lance, a son of H. E. Lance; L. C. Youngblood and C. M. Cogdill. —*Hendersonville* (N. C.) *Times.*

City Sells Sand to Aid Employment

WITH the appearance of Detroit's first snow, J. W. Fay, secretary of the creative employment division of the mayor's unemployment committee, announced that the winter's sale of sand was on. Ninety-pound sacks of clean lake sand, guaranteed to make the iciest sidewalk a non-skid affair, may be bought for 25 c. Mr. Fay said, the business being handled by unemployed men. Several thousand sacks were sold last winter the *Detroit* (Mich.) *Free Press* reports. In Detroit the city also sells sand boxes in the spring and summer to aid in its unemployment relief.

Cement Company to Help Its Unemployed

THE Missouri Portland Cement Co., at its plant near St. Louis, Mo., has announced that, in order to lighten the load which is being carried by organized charities, it proposes to take care of its own idle employes. Food, shelter and clothing will be provided by the company, and the men will be given the chance to repay it in installments over a period of six months when they return to work. Food and fuel will be furnished at cost, with no addition for overhead charges. —*Independence* (Mo.) *Examiner.*

Postpones Annual Meeting

JOHN L. JACKSON, president, Sand-Lime Brick Association, announces that, with the consent of the executive committee, the 28th annual meeting of the association, which was to have been held in Washington, D. C., February 3-4, has been put off until later in the year, if the conditions will then warrant a meeting.

President Jackson also says that the officers will submit their reports to the executive committee for approval during the month of February.

Gypsum Industry Very Much Alive on 25 Percent Capacity Operation

Busy Developing New Products and New Markets

THE DECLINE in volume of gypsum sold or produced in the United States during 1931 followed continued declines from the peak year, 1925. As a result, comparative volume percentages have reached a point where they do not signify the true condition of the industry. However, it might be said that the production and sale of gypsum products last year was such as to utilize about 25% of the present plant capacity.

A year ago we estimated the production for 1930 as 30% under the 1929 production. Subsequent returns from the U. S. Bureau of Mines showed a reduction of 31%, or a total production for 1930 of 3,471,393 short tons. Of this total 2,191,376 tons were sold as calcined gypsum, which includes stucco used for wallboard and plasterboard, partition tile, etc. From questionnaires and other sources of information the reduction for 1931 will be close to 28% below 1930, giving for the year a production of 2,500,000 tons. As the portland cement industry uses by far the greater portion of the uncalcined gypsum sold, and as cement production fell off only 22½% during the past year, the indications are that the total crude gypsum sold was about 725,000 tons, compared to 933,381 tons in 1930. On this basis there would be about 1,775,000 tons sold as calcined gypsum.

Plant prices were maintained at a fairly uniform figure compared to 1930, with no serious evidences of price cutting, although there are indications that some producers intend to absorb the recent freight rate increase on gypsum products. The total gross earnings of the gypsum industry, then, have shrunk only in proportion to the loss in volume.

Cement Industry Should Find a Way to Use Anhydrite

Gypsum for cement mills during 1930 showed an average plant price of $1.89 per ton. For 1929 the average was $1.87. Each year shows considerable depletion in cheaply available high-grade gypsum, which each year becomes more and more apparent, and this will result in marked increases in prices for crude gypsum unless portland cement manufacturers find a way to use crude gypsum containing higher percentages of anhydrite than they have been accustomed to using. There are huge reserve sources of crude gypsum containing variable amounts of anhydrite, cheaply recoverable, which, unless the portland cement industry wants to pay a higher price for gypsum in the future, must be looked to to meet these requirements.

Gypsum containing anhydrite for portland cement retarder is being used successfully by some cement manufacturers. Others have not been so successful. Recent investigations indicate that the presence of sodium and potassium salts have a bearing on the successful utilization of anhydrite gypsum. As artificial anhydrite can be hydrated by the use of such soluble salts, there may be some relationship in this with the use of anhydrite in cement mills. At any event it is becoming more essential for cement manufacturers to make earnest endeavors to use the lower grade anhydrite-gypsum materials.

Active Research and Development

The gypsum industry, for its relatively small size, is *the* outstanding rock products industry as regards the amount of money expended and the variety of the research work being carried out by the individual producers. The research work has centered around the development of new products and new uses for gypsum, and has caused the industry to progress from a mere rock producing and calcining operation to a combination of a highly developed manufacturing and fabricating institution in which gypsum mining and calcining are hardly more than incidentals. The net result has accounted for its progress and placed the industry on a sound footing, and compared with other industries on a profitable basis. A few individual producers spend more for their own research than the entire lime industry expends collectively.

Gypsum for Paper Filler

The United States Gypsum Co. is perhaps the leader in this, and through its efforts has developed at least three times as many new products during 1931 as in any previous year. Many of these products are of minor importance as regards tonnage, but the one big exception was the greatly increased use of gypsum as a paper filler. This year, through its efforts, a potential market has been opened up for finely ground crude gypsum and a dead-burned gypsum which approximates 500,000 tons per year. Thus in a single stroke resulting from research, an old market possibility has been suddenly developed that approaches in tonnage the market provided by the cement industry.

There are several advantages to the paper trade in using gypsum as a filler: (1) The paper will not turn yellow with age, but will retain its white color indefinitely; (2) the paper so treated retains its life; (3) when printing on such paper, the ink dries almost instantly and does not smear or "offset," making it possible for the printer to eliminate the use of smear sheets. Incidentally, the gypsum product can compete with other fillers on a price basis, but only pure white, high-grade gypsum can be used for this purpose. Of all the holdings of the United States Gypsum Co., only three of its mines or quarries, it is said, can produce a material pure enough for this purpose.

The gypsum products used are a finely ground raw gypsum for such paper as envelop stock, and a dead-burned gypsum for the heavier enameled papers. This use of gypsum is obviously not a small market but a carload proposition.

Wood-Grained Plaster Board

In the wallboard manufacturing end of the gypsum business the developments have been towards fabricating and marketing wood-grained paster or wallboard. This product is regular gypsum wallboard with ordinary paper backing but with the top covered with either a printed paper resembling mahogany, whitewood, gumwood, etc., or a thin veneer of the wood itself. The National Gypsum Co. especially is featuring its "Gold Bond" wood-grained wallboard in the popular magazines. The United States Gypsum Co. and the Canada Gypsum Lime and Alabastine, Ltd., of Paris, Ontario, also market similar products.

Wallboard of this type produces an amazingly beautiful effect and replaces costlier wood panel work. Naturally it is not subject to cracking or warping, and is fire-resistant. The sale of this product stemmed quite materially the downward sales trend of ordinary gypsum wallboard due to the depressed building industry and a condition brought about by the host of mineral and non-mineral competing wallboard products.

The Gypsum Lime and Alabastine, Canada, Ltd., introduced two sound-absorbing materials to correct acoustic conditions and an insulating material. These products were a result of its research staff's efforts. The research laboratory is at its Caledonia, Ont., plant near Hagersville.

Examples of the way in which the gypsum manufacturers are meeting wallboard competition with wood grain and other types of gypsum wallboard

The following tabulation, compiled from the Bureau of Mines reports, covers the first nine months of 1931 and the full year of 1930:

		1929 (9 months)	1930
Crude gypsum sold (domestic and imported)	short tons	624,322	989,591
Calcined gypsum produced (domestic and imported rock)	short tons	1,516,289	2,024,831
Wallboard sold	sq. ft.	265,821,730	316,591,528
Plaster board and lath	sq. ft.	176,325,377	258,809,622
Keene's cement sold	short tons	22,542	39,446
Partition tile	sq. ft.	18,384,096	.....

Byproduct Gypsum

The production of gypsum from byproducts continues at the United States Phosphoric Products Corp., Tampa, Fla., at the Alcoa Ore Co., East St. Louis, Ill., and at the Structural Gypsum Corp., Linden, N. J. All of these companies are reported to be producing retarded plasters. The Calumet Chemical Co., Joliet, Ill., has not operated its synthetic gypsum plant since 1928, because of the slackness of the Chicago building industry.

The Rockwood Corp., St. Louis, which in the past had difficulties with the building trades labor when it came to using what was originally called "gypsum lumber," has had these difficulties straightened out and production was resumed. In addition to installing more molding equipment for partition tile, the Rockwood Corp. brought out a tongue and grooved roof section, cut to any lengths to fit the steel purlins. This latter product has met with considerable success. The building of the Los Angeles, Calif., plant of the Rockwood Corp. has been delayed on account of the general financial situation.

Progress in Acoustic Plasters

On the Pacific Coast the various producers of stucco and acoustic plasters, among which are subsidiary companies of gypsum producers, formed the Stucco and Acoustic Plaster Institute, whose purpose is to develop this phase of the industry. The following, extracted from a recent communication from the Pacific Coast, sums up what has been done in that section:

"The acoustic plaster industry, although still in its infancy, is making a noticeable progress, both in quality and in volume, in this community. Much valuable research work has been done during the last 18 months, and the laboratory results have been thoroughly tested out in a practical way. The result has been that the manufacturers, generally speaking, have changed and improved their formulas, thereby considerably increasing the absorption value of acoustic plaster, and any increase in manufacturing cost has been partially or totally offset by the increase in volume of output, even in the face of a considerable drop in building construction.

"Not only have the manufacturers been able to increase the absorption value of their acoustic plaster to where it is now from 50 to 100% better than the products of one year or eighteen months ago, but they are now producing a material that will not shed and will stand any reasonable abrasive or washing tests, and it can be painted or decorated without materially decreasing its absorptive efficiency. The quality, efficiency and color of most acoustic plaster depends, to a large extent, on the quality of pumice used."

Building and Improving for Lower Costs

The building of several large capacity plants during the past few years, while from a production standpoint in a measure apparently uncalled for (the industry already being overplanted), did show the industry the great savings in production costs over the older high cost operations, even in spite of the low production.

Gypsum producers have shown uniformity of thought and action with regard to taking advantage of present conditions to make such alterations and changes as were consistent with the times.

Best Bros. Keene's Cement Co. at its Sun City plant, for example, has abandoned its quarry operations and confined all production to a single level, room-and-pillar mine. The mine has a 6-ft. roof of sandstone under which is mined a horizontal 22- to 26-ft. vein of high purity gypsum. A 2½-mile standard gage railroad has been built to the new crushing plant, eliminating the older aerial tramway. The new crushing plant has a capacity of 200 tons per hour. The entire change ran into six figures as to cost.

No new products were introduced by this company during 1931, although several experimental products introduced in 1930 were expanded to commercial proportions. This included its "Fast Finish" grade of Keene's cement.

One new plant was built at Hagersville, Ont., by the Canadian Gypsum Co., Ltd., a subsidiary of the United States Gypsum Co. This plant used some equipment from one of the company's New York plants, but modernized considerably. There are no elevators or conveyors in this plant, all the finer materials being handled by air conveyors or by gravity.

The plant is of clay tile and steel construction and includes equipment for the manufacture of wallboard. The gypsum is mined through a vertical shaft.

The United States Gypsum Co. also contemplates the erection of a small plant in Nova Scotia.

A novel and practical application of the calcine-while-you-grind apparatus of the Raymond Bros. Impact Pulverizer Co. is reported as being installed in a West Coast gypsum wallboard plant. The device is used to re-calcine board trimmings, faulty boards, and other waste gypsum material. The calcined stucco so produced is reincorporated into the stucco from other sources and reused in the manufacture of the wallboard.

Elimination of dust from kettles has become a necessity at many plants. At an East St. Louis plant a Senseman condenser collector of the Franklin Engineering Co., was installed for this purpose with satisfactory results. This is a wet collector. At a Ft. Dodge plant a new dry collector of Raymond Bros. Impact Pulverizer Co. was installed, with equal success, according to reports.

A Tampa, Fla., producer is also contemplating installing, in the near future, suitable equipment for this purpose.

Canadian Gypsum Production in September, 1931

THE DOMINION Bureau of Statistics at Ottawa reports the production of gypsum in Canada during September at 112,601 tons as compared with 123,790 tons in the preceding month and 95,234 tons in September, 1930. During the month under review Nova Scotia quarries accounted for 88.5% of the total Canadian shipments.

Exports of Canadian crude gypsum consisted of 92,640 tons shipped to the United States. Plaster of paris exports totalled 348 tons. Approximately 44 tons of plaster of paris, not calcined, were imported from Great Britain and the United States during September. Calcined plaster of paris imports consisted of 832 tons from the United States and 50 tons from Germany.

PRODUCTION OF GYPSUM IN CANADA

September, 1931	112,601 tons
August, 1931	123,790 tons
September, 1930	95,234 tons
Nine months ending	
September, 1931	660,004 tons
September, 1930	808,255 tons
September, 1929	940,043 tons

New Mexico Contractors to Open Gypsum Plant

A GROUP of southeastern New Mexico contractors are about to start a small plant for the manufacture of plaster and building blocks at Acme, Tex., according to O. L. Shieles, former chief engineer of the Certainteed Products Corp., which recently closed its plant there.

The contractors have bought a portion of the equipment and will start a plant to cost about $15,000. The plant will employ from 15 to 18 men and will turn out 25 tons of gypsum plaster daily.—*Roswell* (N. M.) *Dispatch.*

Review of Research in Concrete Aggregates in 1931

Trends that Affect Producers

By Edmund Shaw
Contributing Editor, Rock Products

DURABILITY has attracted more attention than the other characteristics of concrete in the past year or two. Design now is for durability rather than strength; see the latest edition of the Portland Cement Association's handbook, for example. Hence it is natural that a great part, perhaps the greater part, of last year's research had to do with the resistance of aggregates to weathering and other disintegrating factors and to correlating the durability of aggregates with the durability of concrete.

Jackson[1] (August 15) says that relatively little disintegration of concrete can be laid to unsound aggregates, but that little justifies complete investigation. He thinks lack of water-tightness is the chief cause of failure. Poor grading of aggregates, regardless of their quality, contributes to this. Research should be made on concretes rather than on aggregates as the quality of the cement paste affects the behavior of the aggregate. This agrees with what some other investigators report, but Jackson's paper alone contains the important suggestion that disintegration may be due in some cases to a difference in thermal expansion between the mortar and the coarse aggregate. He mentions flint as an aggregate which might possibly cause this kind of disintegration.

He also believes, as others do, that disintegration is as much due to the formation of chemical salts in the seams and pores of the aggregate as it is to water freezing in the pores. The paper by Temin, Pigman and Tucker[4] (August 1) concludes that other causes than freezing and thawing effect disintegration, and they found no connection between pore space and disintegration. Their investigation was made on 36 aggregates from 12 states. Tests were by boiling, sodium sulphate, sodium chloride and freezing and thawing. To measure effects they used a "disintegration number," the fineness modulus after testing divided by the fineness modulus before testing. For the materials tested the disintegration numbers were: Granite, 0; trap, 2; gravels, 3.5; slags, 7.5; limestones, 8; sandstone, 14.5. The ratios of Kreuger and Schurecht, used in studying ceramic products, were found of no value in studying aggregates. Clay inclusions were found to affect limestone disintegration.

As complete a study of durability as any is that of Gonnermann and Ward[2-4] (May, August 15) and their results have led to more definite conclusions than those of some other tests. The outstanding conclusion is that the protective effect of the cement paste is all important. Paste with a low water content made durable concretes out of really unsound aggregates. The characteristics of the fine aggregate are especially important to durability. It was found that each sand had a definite permissible water-cement ratio. Some sand that made sound concrete with 4-5 gal. per sack made unsound concrete when more water was used. Shale, chert, argillaceous limestone and argillaceous sandstone were found the least resistant rocks. This paper suggests as definite limits for the sodium sulphate test, 15-20% disintegration for coarse aggregates, and 12-15% for fine aggregates after five cycles.

Goldbeck's tests[2] (April) developed that it was possible to make an unsound mortar with a sound sand and a sound mortar with an unsound sand, both having the same water-cement ratio. He attempted no explanation, but the explanation may lie in what Gonnermann and Ward found regarding the water requirements of different sands. Goldbeck also found that unsound coarse aggregates did not necessarily make unsound concrete. In his freezing and thawing tests the unsound stone did not crack the concrete or leave the mortar or cause pitting. Only until the mortar failed did the unsound stone fail by continuous chipping.

Young[2] (May) says that unsound coarse aggregate seldom causes disintegration, but where it does the disintegration is usually definite and complete. Coarse aggregate may be so protected with mortar that it will last a long time but if the fine aggregate is not durable the concrete is doomed.

Scholer[4] (July 18) found a fairly definite relation between water-cement ratio and resistance to freezing and thawing, testing concretes carefully made so that the water-cement ratio was the only variable. He found the grading of the aggregates affected the water requirement and suggests that separate sizes be used to insure uniformity of grading.

Unsound Materials

There are certain mineral substances so unsound that they can never be used as aggregates by themselves and can be permitted only in small quantities when they are with other materials. Lang[3] (April) divides them into two classes: (1) those which undergo volume change in concrete, and (2) those which tend to make concrete structurally weak. The first class is the most dangerous and includes shales, some cherts, "chocolate bars" and so on. The second class includes not only stones that are structurally weak but those which have adherent coatings. It is noted that no definite line can be drawn because shale, for example, is found in all stages from the soft and unsafe variety to the hard slate.

Groves[4] (May 23) studied the effect of soft substances and found that the so-called soft rock up to 6% and shale up to 4% actually increased compressive strength. Above these percentages additions rapidly lowered the strength. He suggests that the absorption of these soft materials lowers the net water-cement ratio. While it is not concluded that concretes made with these small amounts are safe, it is thought that the results justify long time tests exposed to weather and traffic.

Testing for Soundness

The sodium sulphate test still retains its place in spite of the many attacks that have been made upon it, and it seems to be more highly thought of than it was a year or two ago. Goldbeck, Walker, Love and Hubbard[4] have joined in a statement (August 15, Jackson's paper) setting a limit of 15% disintegration after five cycles for complete unsoundness and 15-20% for doubtful unsoundness that demands a repetition of the test. The National Sand and Gravel Association laboratory has issued a compilation of the best thought on this test[3] (February) including rather exact methods of classifying and interpreting its results.

Lang and Hughes[4] (July 4, A.S.T.M. report) have used a rapid accelerated freezing and thawing test, ten cycles per day. Eighteen gravels, two sedimentary rocks and nine deleterious materials were tested. For such fine grained sedimentary rocks as limestone it was found necessary to use more than ten cycles or longer freezing periods, but the results on gravel were close to those obtained with 24-hr. cycles. They conclude that the durability of aggregates and the

durability of concretes made from them are related, but they say that tests for the quality of the cement paste should be such that the disintegration will depend more on the quality of the aggregates than the quality of the cement paste. A limit of 10% passing a No. 8 sieve after 30 cycles of accelerated freezing and thawing is suggested for coarse aggregates that are to be used in an exposed situation.

Summing Up Research on Durability

To sum up research on durability to date, it has been brought out that: (1) Durability is first of all a matter of cement paste quality. But this is now well understood, and it is common practice already to select a water-cement ratio for durability rather than for strength. (2) The most dangerous substances are those which undergo volume change in the concrete; structurally weak materials will last a long time if protected by good mortar. (3) Sound fine aggregate is important for if the mortar is unsound the concrete is doomed. (4) *But the soundness of fine aggregate is relative,* a sand which may make a quite sound mortar with a certain amount of water will make an unsound mortar if a little more water is used. This is, in the reviewer's mind, the most important thing that has been brought out and it is one that requires further study for confirmation. (5) Grading, especially the grading of the fine aggregate, is very important, first for its effect on the water-requirement of the mix and, second, for its effect on the water tightness of the concrete. (6) There is enough information now so that concrete can be definitely designed to be durable under certain conditions.

Proportioning Materials

The use of coarse aggregate in two sizes is becoming common and in some places the fine aggregate is used in two sizes. An article in *Concrete* for May on the control of paving concrete by state highway commissions says that California and Texas use two sizes of fine and two of coarse aggregate; Arkansas uses two sizes of coarse aggregate on more than 50% of its work. The mix is based on fineness modulus. New Jersey uses two sizes of coarse aggregate which are combined to make the densest possible mix. North Carolina makes all roads with two sizes of coarse aggregate. Washington uses ¼- to 1½-in. and 1½- to 3-in. aggregates combining them for the best grading. Wisconsin uses two sizes coarse aggregate. In Michigan the usual coarse aggregate is ¼- to 2½-in. but two sizes have been used on some jobs and a wider use is expected. Illinois and Texas design concrete by the mortar-voids theory. Many other states proportion the sand according to the voids in the coarse aggregate.

The whole matter of using coarse aggregate in separate sizes was carefully studied by Crum[3] (February). He shows that by using two sizes more coarse aggregate may be used because it is not necessary to "play safe" and use an excess of mortar to allow for the bad grading that might result from segregation. But where coarse aggregate is much more expensive than fine aggregate the advantage of using two sizes disappears, as the cost of more mortar will be less than the cost of extra coarse aggregate plus increased cost of handling and stocking separate sizes.

Meyers and Morris, designing by the method of Talbot and Richart, found that not only the mortar but the whole mix had a basic water content. This was determined by weighing fresh concrete in 6x12-in. cylinders and it was found to vary with the coarse aggregate, being greater with limestone than with gravel. This was due to other characteristics than absorption. The oversanded mixes much used in Iowa highway paving, were found to be of maximum density.

Meyers[3] (April) has also studied the design of mixes to include the finer sizes of gravel. His state, Iowa, is comparatively short of good coarse aggregate deposits. Using an ordinary mix, it would be necessary to take 4 tons of material from the ground to secure 1½ tons of usable aggregate. By including some fine gravel the 1½ tons can be obtained from 3 1/3 tons taken from the ground. The strength of the concrete made with the fine gravel is quite satisfactory.

Hands[4] (August 29) discusses the regular California method of combining aggregates for highway concrete, which is to have the volume of the sand at least 1.3 times the volume of the voids in the coarse aggregate. He also discusses designing mixes from the surface area of the materials. He finds the separate water requirements for cement, sand and coarse aggregate by using trial mixes of the same consistency but with different propositions. From these he writes three equations with three unknown quantities. The surface corresponding to the water requirement is taken from Hveem's table of surface constants used in bituminous paving. The total water requirement is proportional to the total surface exposed. This knowledge enables him to change the proportions of fine and coarse aggregate, to improve workability, say, keeping the absolute volume of the materials and the water-cement ratio constant.

Grading of Aggregates

Undoubtedly the papers which have aroused the most widespread interest in the grading of aggregates are those of Furnas and Anderegg, published in *Industrial and Engineering Chemistry for September.* Prof. Furnas has worked out mathematically the densest mixes for two components and three components and for continuous grading, and Anderegg has tested the theory with mixes of different materials. The dense mixes with three sized components are harsh and could not be placed without effective vibration. The densest continuous mix was found to be that in which each sieve retains 1.10 times the weight retained on the preceding sieve of the system having a ratio of $\sqrt{2}$, that is the Tyler system. With the sieves used for finding fineness modulus the weight retained is about 1.20 instead of 1.10. As the reviewer sees it, the most important thing about this investigation is that it confirms mathematically some things that have been learned empirically, such as the bad effect of "humps" in the grading curve and the fact that the sand portion of Fuller's curve is close to the ideal.

Goldbeck, Walker and Love, as representatives of the National Crushed Stone, National Sand and Gravel and National Slag associations, have agreed on standard sizes of materials for concrete aggregates and other purposes. In describing them Goldbeck[2] (October) says it is unthinkable that the aggregate business should continue with the present lack of system. The article has an excellent discussion of testing sieves with the committee's reasons for preferring square openings for all sizes. It also contains a specification for stone sand which allows 7% of dust. This would be all right if it could be assured that the dust was all the dust of crushing and not dirt from clay seams and from the overburden.

Viens[4] (July 4, A.S.T.M. report) says that the effect of grading kept within A.S.T.M. specifications is not important to strength but may affect workability. It is most important to avoid an excess of material between ⅛-in. and ⅜-in. Fine aggregate should not have too much weight retained on one sieve. A simple rule is that not more than 60% should be retained on two successive sieves. For water-tight concrete, 10-20% of the fine aggregate should pass a No. 50 sieve.

The bad effect of too much material from ⅜-in. down in the coarse aggregate is also noted by Jackson in discussing the Bureau of Public Roads' tests of this year on highway concrete. Much honeycombing was noted in the slabs made with small sized coarse aggregate. No explanation was offered except that it was suggested that the small voids with this small material did not allow the mortar to penetrate to the base of the pavement.

Jackson and Kellermann[4], the authors of the paper describing these tests (August *Public Roads*, October 24) find that workability, as shown by lack of honeycombing, decreases as the maximum size is decreased, even though the variations in the percentage of voids and the b/b_0 ratio are small. Walker[3] (November) discusses this and shows that the percentage of honeycombing is closely related to the surface area of the coarse aggregate and hence to the thickness of the mortar web. He suggests that this may serve as a basis for the design of mix. He also shows that honeycombing is closely related to the amount that the fineness modulus of the complete aggregate exceeds

the permissible fineness modulus as stated by Abrams.

Shaw[4] (May 9) discusses the confusion of methods and sieves used for testing aggregates. There are two recognized systems of testing sieves with square openings and one also officially recognized which has round openings. And there are three standard selections of sieves made from the standard systems, not to speak of differences in manipulation and in the method of reporting. The matter is so bad that engineers have to use charts for converting from one method to another and these are explained and the accuracy of conversion methods examined.

Characteristics of Aggregates

Walker[3] (July) has examined his own work and Goldbeck's on the effect of flat and elongated pieces of aggregate on the strength and workability of concrete. Both found no effect with aggregates containing as much as 15% of flats, but Gilkey, using flat pieces of glass, has shown that shape may be a source of weakness. Walker concludes that further investigation is necessary and suggests that it be made with artificial aggregates, of mortar, terra cotta or glass.

Proudley[2] (February) notes that he has found certain concrete sands are covered with a film that seriously affects mortar strength. It cannot be removed by usual washing methods.

Bachelder reports in *Engineering News-Record,* January, that a loss of strength results from overheating aggregates. Concrete placed at 130 deg. F. lost 20% of its strength.

Goldbeck[2] (March) has studied volume change of concretes made with light weight slag as compared with those made from heavy slag and limestone. There is a strong indication that the concrete made of light slags expands more than the others.

A.S.T.M Committee C-9 found that abrasion was unreliable and incorrect as a test for the concrete making properties of slag. Weight per cubic foot is a better and more consistent test for its concrete making quality. The investigation of this committee was very thorough, including tests for flexural and compressive strength and for wear.

Randall[1] (March) finds that the advantages of using light weight aggregate vary with the height of the building and the floor construction. It would be worth while to pay 10c. more per cubic foot to secure a reduction from 150 lb. to 130 lb. concrete in a concrete frame building 30 stories high. Savings are more favorable in steel-frame buildings.

Types of Aggregate

Discussing Jackson and Kellermann's paper, Goldbeck[2] (September) points out that the very carefully conducted tests of the Bureau of Public Roads show that stone concrete is at least as workable as gravel concrete for the same grading, although this is contrary to a widespread idea and revealed here for perhaps the first time.

Walter and Freeman discuss the report of Committee 201, A.C.I. (February) and indorse what it says about the concrete making qualities of slag. Walter says that the oversanding of mixes in which slag is the coarse aggregate renders them thoroughly workable and does away with harshness.

R. A. Davis and H. E. Davis[1] (March) found that the flow of concrete under pressure is affected by both the type and the grading of the aggregate. The flow of sandstone concrete was about three times the flow of limestone concrete. In order of least to greatest flow, the aggregates stood: Limestone, quartz, gravel, basalt and sandstone.

Noble[4] (July 4, A.S.T.M. report) found pronounced differences in the elasticity of concretes made with different types of aggregates, and he believes that the difference is significant enough so that it should be considered in the design of structures.

A curious concrete specification was used on the Diabolo dam, near Seattle, Wash., according to a paper by Faulkner and Hubbard[1] (February). The mix specified was 1:8 with sand and gravel aggregate, 1:7.50 if the coarse aggregate was crushed stone, and 1:7.25 if both fine and coarse aggregate were of crushed material. The reason given was that it was found that crushed materials required more mixing water for equal plasticity, "resulting in a loss of strength and an increase of permeability." The mix was made to a definite fineness modulus.

Cinders as aggregate were thoroughly studied by Christensen[1] (February), who found that most of their supposed disadvantages as aggregates are due either to contamination by trash and junk or to improper use. He proposes a cinder specification.

Menzel[4] (July 4, A.S.T.M. report) says that while it is true that some aggregates are more fire-resistant than others, it is possible to design to any desired fire-resistance specification by selection of the type of unit, the cement content, the grading of aggregate and the wall thickness.

Foreign Research

Paul Hertel in *Zement* discusses concretes with aggregates graded to the curves of Fuller, Gruen, Herman, Graf and Otzen. Grading the aggregates to Otzen's curve gave the best concrete but it was nearly equaled by grading the aggregates to Fuller's curve.

A German committee for the standardization of sizes of aggregates has finally adopted a set of sizes after several years' work, according to *Tonindustrie-Zeitung*[4] (April 25). Sad to say, the committee adopted sieves with both round and square holes. All sieves with openings of more than 1 mm. dia. have round holes.

A. Janousek, in *Beton und Eisen,*[4] (June 20) says that the sieve analysis of aggregates shows nothing of the shapes, volumes and surfaces of the individual granules. A 32x10x3 mm. stone might not pass a 30 mm. sieve, while a 70x14x12 mm. piece might pass a 15 mm. sieve, although it has 10 times the volume of the first. He thinks that five sieves are enough for controlling the grading of concrete aggregates and suggests sieves with openings of 1, 3, 5, 7, 15 and 30 mm. for coarse mixes and with openings of 1, 2, 5, 10 and 20 mm. for fine mixes. He would like to see these standardized internationally, but as there is no common ratio for either series and as neither offers any perceptible advantages over the set used in this country for finding the fineness modulus, it is hoped his suggestion will not prevail.

G. Kathrein in *Oesterreichische Bauzeitung*[4] (January) studies the effect of stone dust with aggregates. He found additions of 4-10% of limestone dust increased both strength and unit weight. Additions of 20% decreased both strength and unit weight.

M. Spindel in *Tonindustrie-Zeitung*[1] (January) proposes a metric fineness modulus with 10 microns as a base. But while this might be used for aggregates it is especially applicable to fine materials and it gives a method of evaluating the work of grinding.

At the 33rd annual meeting of the German Concrete Institute it was reported that brick was generally preferred for dwellings on account of better insulating properties, but that concrete with pumice stone aggregate and concrete with air and gas cells is now being preferred for small apartment houses[1] (February).

A. Hemmel in *Zement*[1] (February) finds that the shrinkage of concrete is due to several factors, two of which are shrinkage of the aggregates and the grading of the aggregates. Others are the shrinkage of the cement and the quantity of mixing water used.

References

The small reference letters refer to publication in the following:

1. *Journal of the American Concrete Institute.*
2. *Crushed Stone Journal.*
3. *National Sand and Gravel Bulletin.*
4. Rock Products.

Many of the papers mentioned appeared in two or more of these. Generally the reference by letter is to the original publication or to the most complete abstract.

This review does not pretend to be complete, the idea being rather to show the trend of research than to abstract all that was published. Some important papers were not available in time to be included.

Explosives Research Laboratory

AN INTERESTING PICTURE story has been published by the Hercules Powder Co., Wilmington, Del., describing its new research and experiment station.

Illustrations of many of the departments and of various pieces of equipment tell the story of this institution planned to increase knowledge of explosives. A brief description is also given.

Alloy Steel Castings in the Quarry, Cement and Allied Industries

By Raymond L. Collier
Assistant to Managing Director, Steel Founders' Society of America, Inc.

GREATER SPEEDS, heavier stresses and higher temperatures and pressures characterize the modern trend in industry. The rock-products field is no exception. Production schedules of a decade or so ago are totally inadequate to meet present-day requirements.

It is natural that these increased demands for improved structural materials should have led to the development of many new steels and alloys, possessing greater strength and toughness and more exactly adapted to special service functions. Discovery and perfection of these new materials have progressed at such an amazing pace it is little wonder that even experienced designers have found it difficult to keep abreast of new developments.

In the steel foundry field the last ten years have witnessed the advent of a host of simple and complex alloy steels and the rise of the so-called stainless steels and heat and corrosion resistant alloys. The numerous families of alloy steels as well as the various types of heat-treated carbon steels, the special alloys, and the almost limitless and ever-increasing series of combinations in use, make it necessary for those who design, specify or purchase industrial machinery and equipment to have at least a rudimentary knowledge of the materials available; to know something of their characteristics, as well as how and when they may or can be used. It is the purpose of this article to present at least some data which may prove helpful to those in the rock-products industries who have to deal with metal construction problems.

The nonmetallic minerals or rock-products industry is probably the most outstanding example of those in which large volume or output is coupled with narrow margins of profit. The huge bulk of this material produced annually is visualized from the fact that almost 400,000,000 tons, valued at about $700,000,000 was recorded for the year 1929. In the aggregate this means a unit value of less than $2.00 per ton. In operations involving the preparation of such a huge output at such low unit value, the matter of economical machinery and equipment is of vital importance. Nowhere is it more necessary to weigh first cost against probable life of the equipment or its component parts, and to specify construction which will give lowest cost per unit of life, coupled with lowest repair expense. Often equipment on which first cost is greater proves more economical in the long run, because of less frequent replacements and repairs.

Editor's Foreword

A PROMINENT cement-mill operating man on the Pacific Coast recently wrote the editor: "Our expenditures per barrel for maintenance have been decreasing from year to year. However, this is due partly to general increase in operating efficiency and to the use of special materials for replacements."

Among the "special materials for replacements" are the alloy steels described in this article, which was solicited by the editor, with the idea of bringing to readers up-to-date developments in alloy steels; giving them the latest available information as to the places to use them in rock products plants to the best advantage.

—The Editor.

Importance of Abrasion Resistance

As the problem of abrasion is most frequently encountered in the rock-products industries, it rightfully deserves first consideration in a study of this sort. Abrasion is a general term embracing several different types of wearing action, among which are erosion, sliding contacts, with or without the presence of dust or gritty material, impingement coupled with impacts of various sorts, and any combination of these. Factors affecting abrasive action are moisture, presence of corrosive chemicals, velocity of contacts, and duration and nature of contacts with abrasive material.

It is the particular combination of operating conditions which determines the type of metal to use in resisting abrasion. The more common materials which have been successfully used in applications requiring abrasion resistance are manganese steel, various alloy steels containing the following elements in varying amounts and combinations; manganese, chromium, nickel, vanadium and molybdenum; and so-called high-carbon steels.

Manganese Steel

This steel is perhaps the very oldest of alloy steels commercially made and, in certain fields, is still without a substitute. It was evolved by Robert Hadfield in England, in 1882, and was in commercial production there in 1890. The first manganese-steel castings in the United States were made in 1892, and the production has grown to a total of around 100,000 tons yearly.

The U. S. army ordinance specifications, which have been widely adopted, are these:

Carbon	1.00 to 1.40%
Manganese	10.00 to 14.00%
Phosphorus, maximum	0.10%

with a heat-treatment consisting of furnace heating to about 1832 deg. F., followed by a water quench. Generally speaking, this analysis range and treatment produce good manganese steel, but greater knowledge and experience over the years have determined specifications and procedure that result in greatly improved physical properties.

An average of 19 tests by disinterested engineers gave the following physical characteristics of manganese steel made to the above specifications:

Tensile strength	108,460 lb.
Yield point	53,396 lb.
Elongation	33.71%
Brinell (hardness)	200

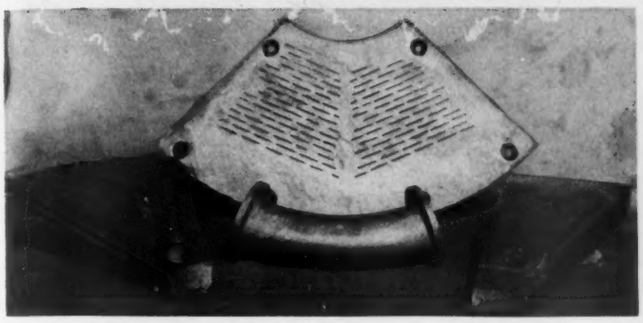
Manganese steel, containing 12.50 to 13.50% manganese, with other elements in proper relationship, and produced by the most modern methods, will run about:

Tensile strength	125,000 lb.
Yield point	50,000 lb.
Elongation	45%
Brinell (hardness)	200

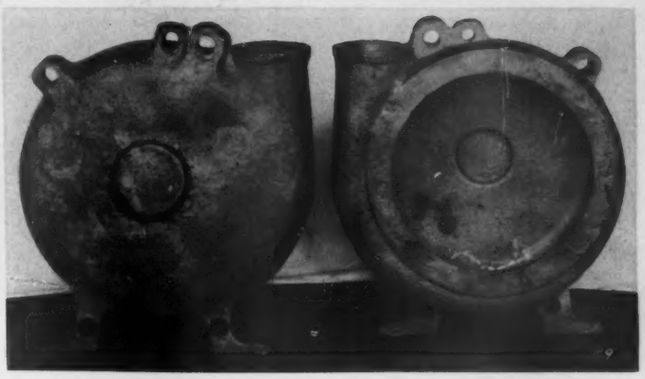
Manganese steel, otherwise known as Hadfield's, standard, or Austenitic manganese steel, has long been in common use in equipment utilized in the rock-products field. Its outstanding properties are: First, its capacity to surface-harden under impact; and second, its ability to build up, under heavy stresses, successively higher yield points. In fact, the surface Brinell sometimes reaches a maximum of 550, and the yield point may, under repeated shocks, finally approach the ultimate strength.

While work hardening increases the Brinell number (and, consequently, the wear-resistance) so that the wearing part presents a hard, self-renewing working surface, the body-metal remains tough and ductile. Under certain abrasion conditions, where impacts are not encountered, manganese steel may not be economical, but, in general, where a combination of strength, toughness and abrasion resistance is required, it is unsurpassed by any simple or alloy iron or steel.

For contacts involved in the crushing of hard material, manganese steel appears to have no equal as regards resistance to shocks



Cement mill castings of chrome-vanadium steel



Chrome-vanadium steel pump castings for abrasive materials

and severe wear. Moreover, sliding contacts with hard or gritty materials such as rock, ore, sand and gravel are applications for which this steel is well adapted, and widely used, although other alloy steels are also being satisfactorily employed to meet these conditions.

Applications of Manganese Steel

Manganese steel has been successfully used in the following applications which are arranged by industrial classifications:

ABRASIVE INDUSTRY—Chain; crusher parts; elevator buckets; gears and pinions; hand hammers; crusher rolls; sprockets.

ASBESTOS INDUSTRY—Beater blades; car wheels; chain; crusher parts; cyclone mill parts; gears and pinions; hammers; power-shovel parts; pulverizer parts; screens; sprockets; tornado mill parts.

CEMENT INDUSTRY—Ball-mill liners; chain; crusher parts; elevator buckets; gears and pinions; liners; conveyor parts; power shovel parts; pulverizer parts; cast screens; woven-wire screens; screw-conveyor parts; sheaves; sprockets; tube-mill liners, gears, yokes and pushers.

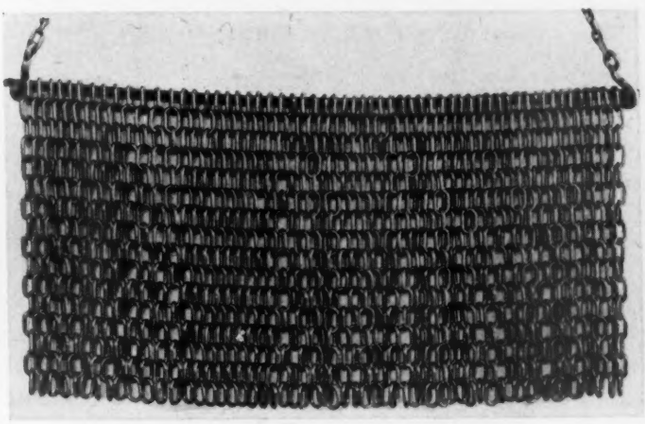
GYPSUM INDUSTRY—Beater blades; chain; crusher rolls; disintegrator parts; elevator buckets; gyratory crusher parts; jaw crusher parts; mixing knives; pulverizer parts; sprockets.

GENERAL INDUSTRIES—Chain; car wheels; crane wheels; elevator buckets; gears and pinions; sheaves; sprockets.

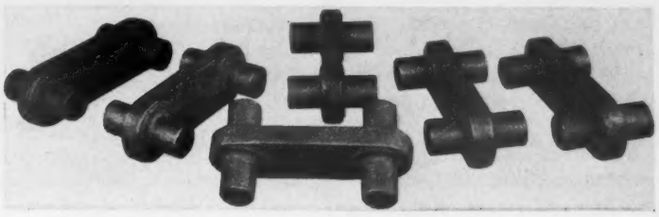
QUARRIES—Car wheels; chain; cheek plates; chute plates; clamshell buckets and parts; dippers; dipper teeth; disc crusher parts; dragline buckets and parts; dust caps; elevator buckets; gears and pinions; hammer-mill parts; grizzly bars; heads; jaw plates; ladder dredge buckets; mantles; power-shovel parts; roll-crusher parts; roll shells; cast screens; sheaves; spider-arm guards; sprockets; toggle bearings; toggle plates; wearing plates.

SAND and GRAVEL INDUSTRY—Chain; clamshells and parts; crusher parts; dippers and teeth; dredge pumps and parts; elevator buckets; power shovel parts; cast screens; sheaves; sprockets; nozzles; wearing plates.

POWER SHOVELS—Backs; bails; bail brackets; boom stirrups; bottom bands; brace arms; bushings; crawler links; crawler sprockets; circular rails; clevises; cutter lips; dippers; dipper teeth; dolly wheels; doors; fronts; hawser pipe; hinges; jack arms; latches; latch guides; latch keepers; latch levers; lips; lugs; padlocks; pins; pinions; propelling sprockets; racks; rail clamps; revolving trunnions; rollers; saddle blocks; sheaves; shipper-shaft pinions; socket castings; swinging circles; tie chairs; traction wheels; winding drums.



Heat and wear resisting alloy steel chains



Center links of nickel-manganese steel for conveyor chains

Quarry car wheels of nickel-manganese cast steel

Various Kinds of Manganese Steel

For conditions to resist wear under light abrasive conditions medium manganese, nickel chrome or manganese molybdenum heat-treated to a Brinell hardness of 250 to 350, will often out-wear high manganese steel castings.

The question of which kind of steel to use depends entirely upon the material to be handled, the strength required, the shock encountered and the abrasive or special conditions to be met. A material that will give excellent service for one application will be found less suitable for another. While some general characteristics will be given for some of the more common carbon and alloy steels, it is well to consult with experienced steel foundrymen regarding materials to

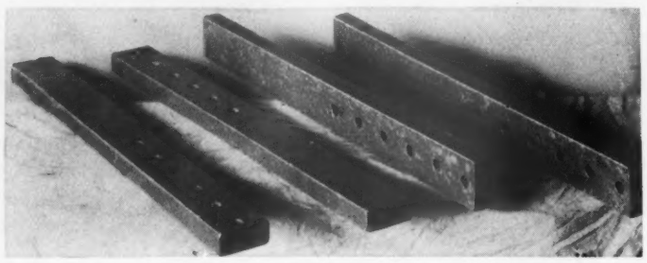
Nickel-manganese steel for pulverizers

meet special requirements. Often more than one steel will recommend itself for a given service, but other attendant factors will sometimes indicate which of these would probably stand up best.

Medium Manganese Steel

Distinct from high manganese or Austenitic manganese steel is one containing about 1½% manganese together with a comparatively high carbon content, known as medium manganese steel, which is giving excellent account of itself for various uses in the rock-products field. Because of its high yield point and good ductility, this steel is well suited for use in heavily stressed moving parts. Certain types of gears, pinions, segments, sprockets, caterpillar tread links, sheaves, mixer blades, power shovel dipper handle racks, ratchet-wheels, tumblers, rollers, etc., are commonly supplied in this grade of steel.

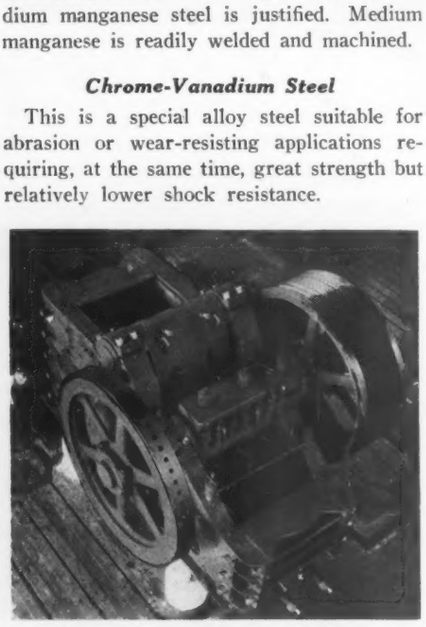
In general, wherever a steel harder and somewhat stronger than regular carbon steel is needed, the somewhat higher cost of medium manganese steel is justified. Medium manganese is readily welded and machined.



Nickel-manganese drag teeth

Chrome-Vanadium Steel

This is a special alloy steel suitable for abrasion or wear-resisting applications requiring, at the same time, great strength but relatively lower shock resistance.



Jaw crusher built entirely of carbon cast steel parts

Common applications consist of castings for clinker plates, compeb mill screen plates, sand and abrasive pipe line fittings, bearing housings, pump impeller housings for cement mill use, etc.

Chrome-vanadium steels commonly show tensile strengths of 160,000 lb. per sq. in., elastic limit of 90,000 lb. per sq. in., and elongation and reduction of area of 8 and 12% respectively.

The accompanying illustration shows four different cement mill castings. The large casting in the background requires a very stiff steel of high tensile strength to resist peening action of severe blows which would otherwise cut down the capacity of the openings.

The elbow casting is for a cement mill conveyor pipe which was cut away very rapidly by abrasives until wear-resisting alloy steel was employed.

The other two castings are wearing plates designed of special alloy steel to resist abrasion by finely divided particles. All of these castings are made of chrome-vanadium steels.

Another view shows two chrome-vanadium steel pump impeller housings for handling water containing sand and abrasive materials in cement mill work.

Nickel-Chrome-Molybdenum Steel

This is a steel which is tough and rugged, well adapted to service involving hammering action and abrasion, and is used for segment plates in rock crusher mills, slugger plates, and the like. It is particularly suited for use where depth hardening is desired in castings of extra heavy section.

Nickel-Chrome Steels

These steels are well adapted to many uses in the rock products field. While able to withstand severe abrasion, when this condition is coupled with shock or impact stresses and fatigue, the nickel-alloy steels are sometimes found superior. They are giving excellent service in sheaves, bevel and other types of gears, power shovel dipper handle racks, chain sprockets and chain, crusher jaw plates, crusher roll shells, etc.

Practically all of the alloy steels require special scientific heat-treatment to develop maximum strength and wear resistance.

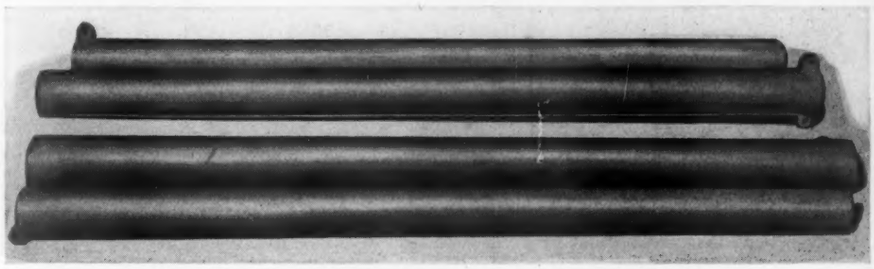
Another illustration shows a quantity of heat and wear-resisting alloy steel chain, which is available cast integrally up to six-foot lengths. It is interesting to note that heat-resisting chain cannot be successfully forged, which has given rise to the cast steel product.

Conveyor screws are furnished in any grade of carbon or alloy steel, cast in one piece with a hollow center. These come in any pitch, diameter or length and are smooth and uniform, with no parting ridges to interfere with free movement of material, being made by a new method.

Nickel-Manganese Steels

Another steel which has a wide field of application in the rock and rock-products industries is nickel-manganese steel. A typical set of physical properties after heat treatment are: tensile, 160,000 lb.; elastic limit, 125,000 lb.; elongation, 12%; reduction of area, 25%. The relatively high ratio of elastic limit to ultimate tensile strength is notable, as are its ductility factors for a steel of such great strength.

It has been used with good results for quarry car wheels; stone pulverizing hammers for cement and gravel operations; drag teeth for cement mills where severe abrasive conditions are encountered, coupled with moderate impact; center links for conveyor chain and sprockets, and similar exacting uses.

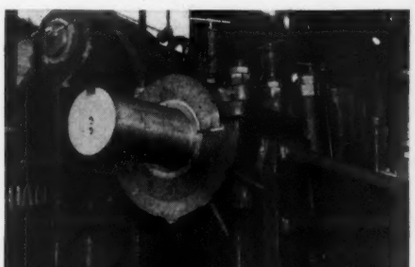


Heat resisting chrome-nickel slurry feed pipes

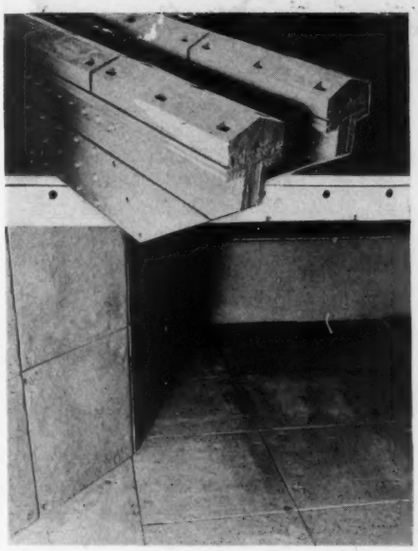
The accompanying photographs illustrate a few of the applications for which this steel is commonly employed.

Heat-Corrosion Resistant Alloys

The last decade has witnessed the advent of a series of chrome-nickel alloys in many of which the iron content is less than that of the alloying metals, in some instances less than 10% by weight. Because of this they



Jaw crusher frame of carbon cast steel



Manganese grizzly bars and plates

are generally referred to as alloys, and not as alloy steels.

Their principal value lies in their high resistance to corrosion at high temperatures. Wherever cracking, warping, bending or burning of parts is experienced, one of these alloys will be found to prolong the life and cut maintenance costs of such equipment.

A typical application is the slurry feed pipes in cement mills, used at the charging end of the cement kilns to convey the cement slurry from the tanks to the kilns.

These alloys give good service in equipment and parts operating under temperatures as high as 2000 deg. F. Temperature ranges, pressures and other attendant conditions determine the particular type of alloy to best meet the requirements.

Carbon Cast Steel

Special service requirements demand special alloy steels; but where shock, abrasion and high temperatures are not encountered. plain carbon cast steel will often be found an excellent material for general structural purposes.

Responsible foundries do not recommend alloy steel castings where they believe regular carbon steel parts will function as well, even though it is sometimes necessary to increase the dimensions and weight of the castings. At the same time they often make friends but lose customers, because the alloy castings last so long that replacements are few and far between.

An outstanding feature of carbon cast steel which recommends it for use in a wide series of applications is its combination of high tensile strength and ductility, which gives it a high degree of toughness, thus enabling it to withstand great dynamic and static stresses without failure.

To convey an approximate idea of the physical properties being obtained from plain carbon cast steel, the following table is presented. The data were obtained from a statistical summary of *all* tests for an entire year, comprising results of 303 separate tests on plain open-hearth carbon steel produced by a typical steel foundry. The grade of steels represented conforms closely to what might be termed a 0.25 carbon steel, which corresponds to much of the steel commonly used for the production of commercial carbon steel castings.

Manganese steel parts on shovels

The monthly averages are given to show the consistent, uniform test results obtained. While these figures are for open-hearth steel, similar results are obtained on comparable grades of steel as produced by other types of melting furnaces.

It is of special importance to note that tensile strength and ductility are controllable within fairly wide ranges according to the heat-treatment given a particular steel. Carbon steels with tensile strengths as high as 90,000 and even 100,000 lb. per sq. in. are regularly being made, but for castings requiring average strength and greater ductility the more or less standard grade having a tensile strength of 70,000 lb. will be found adequate

One advantage in using carbon steel is that it can be readily welded in case of fracture, without taking special precautions and using special equipment. All welds should be subsequently annealed.

The accompanying illustration shows a large, all steel, jaw crusher and gives a good idea of the construction of the steel castings which go to make up these machines. They are built throughout of carbon steel castings.

Were it absolutely necessary to reduce the weights of certain parts of these machines, due to difficult transportation over mountain roads or definite load limits of bridges, alloy steel castings might be used, but for the majority of such castings straight annealed carbon steel is employed.

There is a very definite reason why massiveness and weight is necessary in a rock crusher. Under heavy duty the crusher is subjected to considerable pounding, and the weight and mass of the castings absorbs these shocks very much better than light alloy steel castings which might deflect and spring under these heavy strains.

There are some who still cling to the theory that cast iron of great weight is necessary in a crusher frame to absorb shocks. There is some apparent verification of the statement about iron absorbing shocks. As an illustration: standing at the end opposite the jaw of a large heavy iron crusher, there is very little vibration noticed from the crushing, whereas in a steel machine you can feel every minute vibration of the jaws even at the rear end of the machine. Some of the earlier types of steel crushers had their various parts designed to give

Manganese steel mantle for gyratory crusher

TABLE OF PHYSICAL PROPERTIES OF OPEN HEARTH PLAIN CARBON STEEL—AVERAGE OF ALL TESTS FOR PERIOD OF ONE YEAR

	T.S.	Y.P.	Elong. in 2 in.	Red. of area, %	C.	Mn.	Si.	P.	S.	No. of tests
January	73,540	40,408	29.10	50.02	.24	.68	.31	.044	.038	29
February	73,480	40,000	29.30	51.29	.25	.72	.32	.040	.034	23
March	73,681	39,160	28.84	50.50	.25	.68	.30	.040	.034	44
April	72,880	40,100	28.73	52.33	.25	.74	.31	.042	.036	48
May	70,784	38,451	27.89	48.35	.23	.64	.32	.044	.035	29
June	72,780	39,500	28.75	51.61	.25	.66	.31	.042	.038	33
July	71,980	40,173	27.80	49.90	.27	.66	.32	.044	.040	13
August	71,104	40,291	29.66	47.15	.26	.74	.31	.042	.039	12
September	70,240	38,557	30.60	47.72	.28	.79	.33	.044	.040	13
October	73,220	40,190	29.60	48.60	.25	.67	.33	.042	.038	25
November	73,318	40,988	27.70	44.91	.26	.67	.31	.045	.039	22
December	71,909	42,568	30.29	47.01	.25	.67	.29	.039	.032	12
Average 1930	72,409	40,032	29.02	49.11	.25	.69	.31	.042	0.37	303

equivalent strength of an iron casting, but did not have sufficient actual mass in their construction to absorb the crushing strains and shocks. Modern frames and parts are more rigid and of heavier weight than is absolutely necessary to do the work of crushing, and in many cases weights are actually as heavy as they would be in a cast-iron machine of the same size.

Box type of construction seems to have an advantage over the open ribbed panel type, adding materially to the rigidity of the castings. Where the panel type construction is used, they are usually braced horizontally and longitudinally so that all strains are taken up by more than one compression or tension member.

Machines such as these have been subjected to service for more than sixteen consecutive years without showing the slightest signs of weakness or fatigue of the metal. Of course, precision, finish and machine work have a great deal to do with their long life.

Again let it be said that in selecting steels suitable for given conditions of service it is well to consult the steel foundryman. Experience with the behavior of the various carbon and alloy steels in definite applications and under varying functional conditions enables him to give advice founded on experience and a scientific knowledge of cast materials.

Cement Slurry Filtration During 1931

By A. W. Robinson

Oliver United Filters, Inc., Chicago, Ill.

IN A LITTLE MORE THAN SIX YEARS slurry filtration has developed from an experiment in one plant to such general usage that at present approximately one-fourth of the raw material of all wet process cement plants in the United States is filtered. Twenty-one plants now have filters successfully operating on fifty-six kilns with a normal annual production of 25,000,000 bbl. of cement, meeting all types of raw material, fuel and kiln conditions.

During 1931 two plants have been completely equipped with filters, a third is now in process of installation, and two other plants already using filters have put in additional ones to complete their installations. In addition to the new filters installed, marked advances have been made in the matter of kiln feeding devices and filter control which should be of interest to the industry.

* * *

Two New Filter Installations

The new filter installations made were at the Aetna Portland Cement Company, Bay City, Michigan, and the Lehigh Portland Cement Company, Mason City, Iowa.

At the Aetna plant filters were installed on two 10-ft. by 175-ft. kilns and were operated continuously from May until the winter shut-down. Although no plant details or operating data can be given at this time, the results obtained were exactly in accordance with preinstallation predictions and were obtained quickly due to excellent installation and careful operation.

The Lehigh Portland Cement Company at Mason City, Iowa, installed filters on four 9-ft. by 140-ft. kilns. The installation is unique in several respects, the arrangement of filters and means of getting filter cake to the kiln being different from any other installation. It is of further interest due to the fact that until 1927 this plant was operated on the dry process and the successive methods of operation—dry, wet and with filters—all with the same kilns, fuel and raw materials, should offer a very interesting comparison when complete data is available.

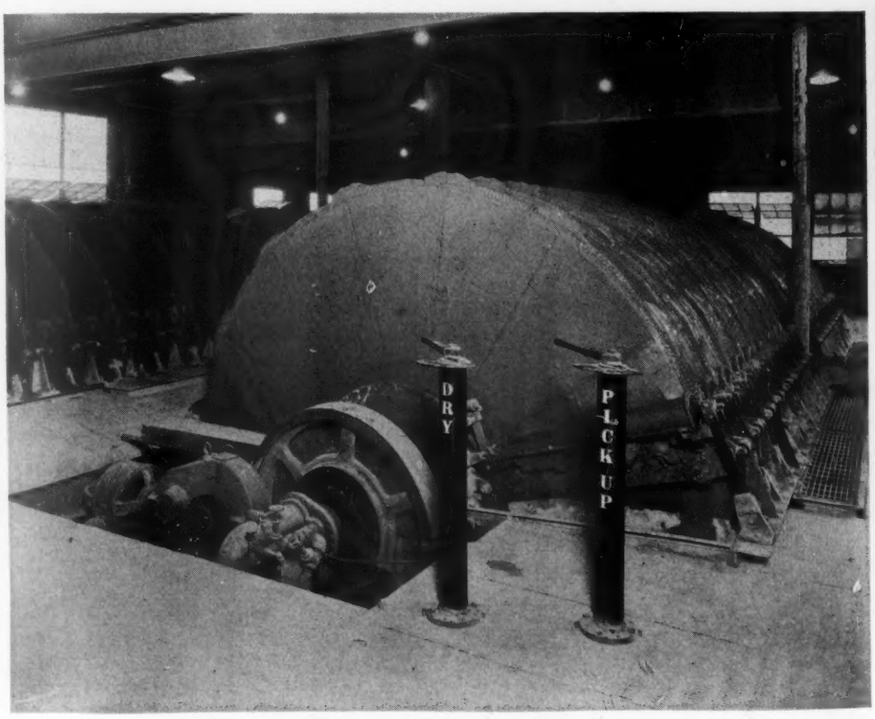
* * *

The Southwestern Portland Cement Co., at its Osborn, Ohio, plant, after operating throughout 1930 with two kilns equipped with filters and the third on slurry, in 1931 equipped the third kiln so that the entire output is now on filter cake. This was the first wet process plant in the country to successfully reintroduce to the kilns all dust recovered from electrical precipitators. Pug mills mix the filter cake with dust amounting to approximately 10% of the raw material, and provide a homogeneous kiln feed in which the dust is so mixed and wet down that no more than 2% of the raw feed is recirculated.

* * *

The Arkansas Portland Cement Company with filters in operation since September, 1930, has developed in 1931 the largest output of any single kiln in the country—either wet or dry process, with a monthly average of approximately 90,000 bbl. and daily outputs as high as 3400 bbl. This plant also is the first "long kiln"—11 ft. 6 in. by 300 ft. —to be operated with filters. The fuel saving and increase in output accomplished are exactly in accordance with predictions based on operating results on slurry and calculated from principles worked out from filter operation on other kilns. The actual fuel saving and increased output are larger than any other filter installation, as the amount of water per bbl. removed from the slurry is also largest. These results prove the adaptability of filters for long as well as short kilns.

As a result of the experience at the



One of the new filter installations

Arkansas Portland Cement plant, the Oklahoma Portland Cement Co., under the same management, is now installing filters over its three 10-ft. by 240-ft. kilns at Ada, Okla.

* * *

The Federal plant of the Bessemer Cement Corp. at Buffalo, New York, is the only one known to the writer with wet dust collectors, where the recovered material is returned to the kilns. The exit gases at 1400 deg. F. are spray-washed in a washer designed by the company engineers. The wash water is thickened in a gravity thickener and the sludge from it is pumped to a small disc filter in line with the regular slurry filters. Filter cake from this sludge is then thoroughly mixed in a pug mill with the slurry filter cake and the dry dust recovered from the kiln housing after which it is fed to the kiln through the Kronstadt shell type kiln feeder. Previously, this sludge was simply mixed with the slurry and filtered in the regular slurry filters, but due to the hydrating effect of the partially burned clinker, the average cake moisture of the entire filter cake was considerably higher than at present. The separate filtration of the sludge from the washer effected a saving of approximately 45 lb. of water per bbl. of cement, which made a saving of approximately 7 lb. per bbl. in the fuel consumption.

An additional installation made during the year

Kiln Feeding Devices

In earlier filter installations water jacketed feed screws were used to feed most of the kilns. Some filter cake was such that it could be fed through inclined pipes without screws, but most cake was too sticky for this.

When dust was returned to the kiln, however, it gradually built up a hard cake between the screw and water jacketed pipe, which often stalled the feed screw, as the result of which a number of screws were discarded and unjacketed feed pipes substituted. These pipes being smaller in diameter than the water jacketed pipes offered less resistance to the flow of gases, could be installed on a steeper pitch, and the cake had less tendency to stick on the hot pipe. Special heat-resisting steels were used where exit temperatures were high. The use of pug mills to thoroughly mix dry dust and filter cake has given a drier feed which also works to the advantage of the unjacketed pipes. However, in almost every instance continuous operation has been rather uncertain and usually an extra operator is required to watch the feed pipes for plug-ups even when compressed air or steam has been used to assist the cake down the pipes.

About two years ago, the Bessemer Cement Corp. developed the Kronstadt shell type kiln feeder which was installed originally in its Bessemer plant. This feeder delivers the cake from a vertical chute through slots in the kiln shell near the feed end. It requires no power, offers no obstruction to the free flow of gases, and requires practically no attention. It has handled the stickiest of filter cake, and the addition of dust has caused no appreciable difficulty. It has proven to be the most generally satisfactory kiln feeding device used, and has now been installed in five plants on a total of ten kilns.

Review of Cement Slurry Filtration to Date

A brief review of present filter installations gives the following information:

CONDITIONS MET

Raw materials—Limestone-clay, limestone-shale, limestone-slag, marl-stone clay, chalk, cement rock.

Number of installations—21 plants with 56 kilns.

Kiln sizes—Diameter 8 ft. to 11 ft. 6 in.; length 100 ft. to 300 ft.

Fuel—Bituminous coal, natural gas.

Slurry moistures—32-50%.

Installations with waste heat boilers..... 15

Dry dust precipitators..... 5

Wet gas washers..... 3

Closed Circuit grinding..... 2

RESULTS OBTAINED

(1) *Fuel reduction*—25-45 lb. coal per bbl. (or equivalent in gas).

(2) *Increased kiln capacity*—20-40% whenever desired.

(3) *More uniformly burned clinker*—Small size results in better burning and grinding conditions.

(4) *Elimination of mud rings* — wherever previously experienced.

(5) *Reduction in clinker rings*—In several installations.

(6) *Improved raw grinding*—Slurry moisture set for best raw mill conditions without affecting moisture in kiln feed.

(7) *Utilization of flue and precipitator dust* —From either dry or wet dust collectors.

(8) *Saving in water by reuse*—Important where water is purchased or supply limited.

Summary

Following is a table showing cumulative totals of plants equipped, kilns equipped and annual production from the year 1925, when the first successful cement slurry filter installation was made, to the present date. This indicates the rapid increase in the use of cement slurry filters after the first few installations had been in a sufficient length of time to be given a thorough trial.

TOTAL FILTER INSTALLATIONS, 1925-31

Year	Total plants equipped	Total kilns equipped	Annual production, bbl.
1925	1	2	890,000
1926	1	2	890,000
1927	3	10	3,230,000
1928	6	17	5,471,000
1929	13	36	14,816,000
1930	19	48	22,100,000
1931	21	56	25,000,000

Bauxite

THE following production and value statistics on domestic bauxite are from reports of the United States Bureau of Mines:

Year	Long tons	Value
1926	392,250	$2,415,2[illegible]
1927	320,940	1,988,[illegible]
1928	375,426	2,273,[illegible]8
1929	365,777	2,265,538
1930	330,612	1,928,297

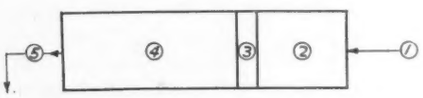
Improvements Resulting from Closed Circuit Grinding

By D. C. Coulson
Superintendent, Nebraska Cement Co., Superior, Neb.

CLOSED CIRCUIT GRINDING in the preliminary compartments of the raw mills and complete closed circuit grinding in the finishing mills were important additions made in 1931 to increase quality and reduce manufacturing costs.

In the raw grinding department the capacity of the mills was increased to 57 bbl. per hour by reducing the mill feed to minus 1¾ in. This was done by welding ⅜ in. steel rods across the diameter of the 3½ in. round holes in the revolving screen between the Fairmont crusher and the Williams mill. The capacity of the Williams mill was increased to take the extra load by installing grids with 1½ in. openings in place of the solid breaker plates.

Hum-mer screens were then installed as the first step in arranging the mills for closed circuit grinding. When increased grinding capacity and efficiency are required, the installation will be completed by arranging the finishing compartments of the mills with hydraulic classifiers.

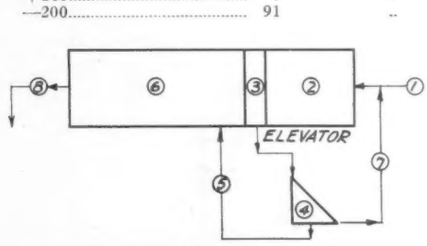


Flow sheet No. 1, without screens

(1) Feed, minus 1¾ in. size, 57 bbl. per hr.
(2) Preliminary compartment, 5½ ft. diam., 5 ft. long, 30% volume, 2- to 4-in. steel balls.
(3) Inside screen, 3/16-in. by 2-in. slots.
(4) Finishing compartment, 16½ ft. long, 45% volume, ¾-in. by 1-in. and 1½-in. steel reinforcing scrap.
(5) Finished product, 35 to 36% water.

SCREEN ANALYSIS

Size	% on	% Cum.
+ 20	1	1
+ 40	1	2
+ 60	2	4
+100	2	6
+200	3	9
—200	91	..



Flow sheet No. 2, with screens

(1) Feed, minus 1¼-in. size, 75 bbl. per hr.
(2) Preliminary compartment, 5½-ft. diam., 5 ft. long, 28% volume, 2- to 4-in. steel balls, ball load reduced to allow for increased circulating load, mill equipped with spiral feeder.
(3) New division head arranged for outside discharge, 2-in. by ⅜-in. slots.
(4) Two 4- by 6-ft. 45 deg. screens set to make 20 mesh separation.

Mesh	(5) Undersize % Retained	(7) Oversize % Retained	(8) Finished product % Retained
4	....	16.5	.....
10	....	24.6	.....
16	....	19.6	.....
20	1.0	8.2	.....
40	11.1	6.6	.....
60	6.6	1.7	0.05
100	6.1	1.1	1.00
200	9.0	1.7	6.85

Detailed data on the mills before and after the installation of the Hum-mer screens are shown on the accompanying flow sheets Nos. 1 and 2.

The results of the Hum-mer screen installation have been as follows:

(1) Better kiln feed—although the 200 mesh fineness is the same with the screens as formerly, 97 to 98% of the product will pass 100 mesh and the small amount of plus 20 mesh material is entirely eliminated. The absence of the coarse material (plus 60 mesh) in the kiln feed allows a higher CaO content with no danger of unsound clinker, resulting in an easy grinding clinker and high quality cement.

(2) The mill output was increased from 57 to 75 bbl. per mill hour, an increase of 31.6%.

(3) The power consumption was reduced from 5.23 kw.h. per bbl. to 3.76 kw. per bbl., a reduction of 28%.

In the finishing department Hum-mer screens were installed in February and the air separators were started in closed circuit with the finish mills in May. The finish mill results on the clinker produced from slurry made by means of Hum-mer screens in connection with the raw mills were the best ever obtained previous to installation of the air separators.

Detailed data for both open and closed circuit grinding are shown on flow sheets Nos. 3 and 4.

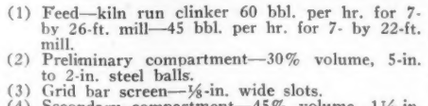
The results of the air separator installation are as follows:

(1) Increased cement strengths for 3, 7 and 28 days.

(2) Increased mill capacity of the 7 ft. by 26 ft. mill from 60 to 87 bbl. per hour or 45%, and an increase on the 7 ft. by 22 ft. mill from 45 to 65 bl. per hour, or 44.3%.

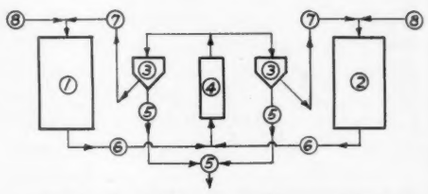
(3) Reduced power per barrel from 7 to 4.98 kw.h. or 25% (including 125 hp. additional connected load).

(4) Reduced temperature of cement of 100 deg. F.



Flow sheet No. 3, without separators

(1) Feed—kiln run clinker 60 bbl. per hr. for 7- by 26-ft. mill—45 bbl. per hr. for 7- by 22-ft. mill.
(2) Preliminary compartment—30% volume, 5-in. to 2-in. steel balls.
(3) Grid bar screen—⅛-in. wide slots.
(4) Secondary compartment—45% volume, 1¼-in. to ⅝-in. steel balls.
(5) Finished product 90 to 91% through 200 mesh.



Flow sheet No. 4, with separators

(1) 7- by 26-ft. compeb mill 87-90 bbl. per hr.
(2) 7- by 22-ft. compeb mill 65-70 bbl. per hr.
(3) 14-ft. Sturtevant air separators.
(4) Elevator.
(5) Finished cement—93 to 94% through 200 mesh.
(6) Separator feed 65 to 67% through 200 mesh.
(7) Separator rejects—32 to 38% through 200 mesh.
(8) Feed.

BRIQUETTE TESTS, LB. PER SQ. IN., 1 TO 3 SAND MIXTURES

	Without separators	With separators
24 hr.	170-180	175-190
3 day	260-290	270-300
7 day	310-320	340-360
28 day	420-450	420-460

Three Large Cement Plants Complete No-Accident Year

"HAPPY NEW YEAR" had a double significance this year for hundreds of cement workers. For three of the country's large cement plants, the Northampton, Penn.; Leeds, Ala.; and Independence, Kan. mills of the Universal Atlas Cement Co., went through 1931 without a single lost-time accident. This was announced by B. F. Affleck, president of the company. The Northampton plant is the largest in the country ever to operate a full calendar year without a lost-time accident.

Announcement of this record marked the second outstanding safety achievement made by the Universal Atlas company during 1931. In June, all nine of the company's plants went for a month without a single lost-time accident.

Cement Bids Received

BIDS for 2,000,000 bbl. of cement to be used in road construction in 1932 were received December 17 by the Indiana state highway commission. There were 17 bidders and the prices quoted ranged from $1.16 to $1.37 a bbl., and were said to be almost identical with those of last year and of a few weeks ago.—*Indianapolis* (Ind.) *News.*

Developments in Machinery and Equipment

AS USUAL, progress in the rock products industry is well illustrated by developments in new machinery and equipment. Most of these were recorded and described during the year, so only mere mention is made of them here. Some manufacturers like to hold up these announcements for the new year, so it happens their products receive more attention in this particular issue. The following pages are designed wholly to make our record of new machinery and equipment in the rock products field 100% complete for the year 1931. The editors are not intentionally duplicating any previous description of a piece of equipment that has been published in these columns.

Explosives and Accessories

The Atlas Powder Co. announced new gelatins, manufactured in straight, ammonia (giant), quarry, permissible and semi-gelatin types, for which the following advantages are claimed; Poisonous gases reduced to a minimum, cartridges made of gelatin paper, density based on blasting efficiency, practically non-freezing, and sensitiveness for complete detonation but reconciled with safety in handling. The Atlas company also announced its new electric blasting caps.

The Cordeau connector (Rock Products, November 7) introduced by E. I. du Pont de Nemours and Co., is reported to have proved very satisfactory and is a decided improvement over the old method of connecting trunk line Cordeau-Bickford detonating fuse to the branch lines.

A circuit tester to test the approximate resistance of the wiring system before it is brought into actual use, so as to prevent misfires in blasting was also introduced by the du Pont company. (Rock Products, May 9).

Drills and Drilling Accessories

The Cleveland Rock Drill Co. introduced an H-77 series of sinkers, the chief feature for which is claimed ease of handling. Model H77D, a dry drill with chuck for ⅞-in. Hex x 3¼-in. shank is claimed to drill holes in any rock to depths of 25 ft. Model H77W has the wet construction and Model H77WL is for shaft sinking and other similar heavy wet drilling jobs.

The Gardner-Denver Co. brought out two new drills, models 107 and 411; model 107 an 89-lb. drifting drill for soft and medium hard formations; model 411, 39-lb., featuring four-pawl rotation, renewable chuck liner and powerful blowing device. This company also announced a new hand rotated stoper (Rock Products, September 12). Another addition to its line is the DS-2 Gardner-Denver sharpener. This is a small drill steel sharpener which the manufacturer states is designed for those using hand drills. The machine is operated with two die pistons in tandem. Both are used for clamping and upsetting. One piston only is used for fullering and gaging. (Fig. 2.)

Fig. 1. Scout drill for prospecting

A single throttle valve controls the fullering, clamping, and dollying operations.

This sharpener, whose bare weight is 1,370 lb., is said to be designed to handle steel in cross section to 1⅛ in. and to make bits having a maximum diameter of 2½ in. Standard four-point cross bits, six-point bits, and McLellan type bits are made with regular equipment.

The Sullivan Machinery Co. announced the introduction of the Sullivan class "E" sharpener (Rock Products, September 26). This company now announces that the so-called "Readyset" bort bits are now obtainable complete and ready for use. These are available in all standard sizes from "EX," removing 15/16-in. cores, to "NX," removing 2-in. cores. It also announces the use of "round shoulder" bits for diamond drilling, made possible by the adoption of the small bort just referred to. The manufacturer states that by rounding off the outside shoulder, or cutting edge of the bit, approximately 40% more bort can be set than in the old standard type of square shoulder bits. Direct benefits resulting from this, it is claimed, are a large increase in drilling speed and a reduction in the cost of bort wear, or loss per foot of hole.

The Keystone Driller Co. announced a new well drill suitable for mounting on a 1½-ton truck (Rock Products, November 7).

The Star Drilling Machine Co. announces its No. 41 "Speed-Star" drilling machine. This is of all steel construction and its double crank drive is said to balance the drilling load on frame, and with spudder drive, mast and bull reel lined up with center frame, the manufacturer states, side strain is eliminated. It will drill with either wire line or manila cable. Either gasoline or electric power can be furnished. It is available in non-tractor type, as a tractor with round wheels or crawler wheels or for mounting on truck. The manufacturer states it will swing a 4¼x20 ft. stem with 5⅝-, 6- or 8-in. bits, and will drill to a depth of 500 ft.

The E. J. Longyear Co. announces its BD scout drill for core drilling of moderate capacity and light weight particularly adapted for prospecting when exploring new areas but suitable for blocking out stone and keeping reserves in proper relation to production. This drill weighs 1350 lb. and consists of drill, hoist and Novo gas engine. It will recover core from ⅞- to 3½-in. in diameter. The drill is chain driven. Angle holes may be drilled by shortening the braces to the head and taking the proper number of links from the drive chain. The swivel head mounting is said to be designed so that the head may be easily and quickly swung aside to provide ample working space. (Fig. 1.)

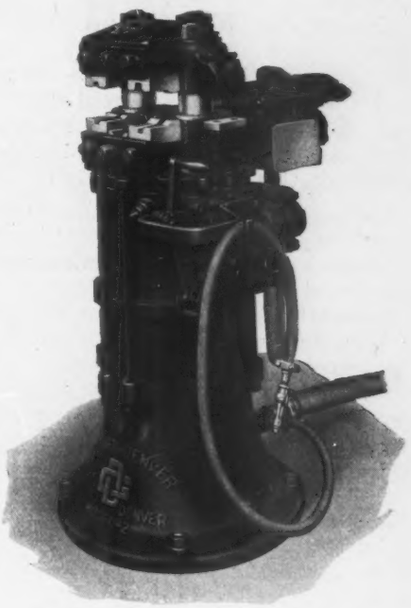


Fig. 2. Sharpener for hand drills

Electrical Equipment

The Electric Machinery and Manufacturing Co. announces a new frequency changer set to provide means of obtaining alternating current at frequencies either above or below those of the usual 60-cycle source. Equipment which may require special frequencies are vibrators, vibrator conveyors, welding machines, etc.

These frequency changer sets can be supplied to give any frequency desired for the operation of special apparatus, the manufacturer states.

The Kohler Co. announced two new small electric plants furnishing standard 110 or 120-volt current (Rock Products, December 19). The Reliance Electric and Engineering Co. announced a small one unit motor generator set which can be furnished for either two or three-phase circuits of any standard voltage or frequency (Rock Products, April 11). D. W. Onan and Sons announced a line of alternating current electric light plants (Rock Products, December 12).

The General Cable Corp. announced that insulated aluminum wires and cables are being sold by it under the trade name "Alectral" (Rock Products, May 9). It also announces the development of a new and improved rubber compound which is now used on "Rome" superservice power cables. This new compound is said to have a tensile strength of 4500 lb. per sq. in.

The General Electric Co. announced a development which amplifies an electric current 10 quadrillion times. The Edison Storage Battery Co. announced a new series of large capacity batteries. Two new "Tungar" battery chargers, a 12-battery and a 24-battery full wave charger are announced by the General Electric Co. It also announces that code wire is being manufactured with colored rubber insulation (Rock Products, December 5).

Floodlights

A number of new lighting devices were announced by the General Electric Co. The Novalux handy floodlight, a 100-watt general utility floodlight projector was announced (Rock Products, April 11). This company also announced an open type floodlight where an inexpensive and efficient unit is required (Rock Products, October 24). A new submersible floodlight was also announced by it (Rock Products, November 21). A new and larger floodlight, the "Senior," designed for general utility floodlighting and employing a 200-watt incandescent lamp has also been announced. This new lamp weighs approximately six pounds and measures less than 15 in. in height with its supporting stand and has a depth of 12½ in. from center of lens to the tip of the holder. A new outdoor Novalux photo-electric controller which responds to the increase and decrease of daylight intensity designed to control floodlight installations, electric signs and electric lighting is now announced by the General Electric Co. This controller consists of a weatherproof case enclosing a light-sensitive photo-electric "eye," a vacuum tube, contactors and time delay relays. With this development lights are automatically turned on or off when the light intensity reaches a definite point.

Lubrication

To handle the heavier and more viscous greases the Hills-McCanna Co. is marketing a new type of grease pump specially designed for pumping heavy mill grease (Rock Products, January 17). This company also has announced that its lubricators are now available with either the "Kam-Klutch" drive or the ratchet type of driving mechanism (Rock Products, February 28).

New developments announced by the Pennsylvania Lubricating Co. include "Penola" leaded compound in various forms to meet the demands for an extreme pressure lubricant in the lubrication of gears and bearings. It is claimed to have from five to six times the film strength of an ordinary oil of the same physical characteristics and is manufactured in 11 grades of consistency to meet all requirements as regards viscosity. Another development is "Penola" heavy duty roller bearing lubricant "X" series. This grease product is said to possess extreme film strength and to furnish ideal lubrication where bearing pressures of industrial roller bearings are such that ordinary greases are not safe to use.

Another announcement was of colloidal graphite for high temperature lubrication by the Acheson Oildag Co. (Rock Products, August 1).

Hoists and Cranes

The R. H. Beaumont Co. introduces the Beaumont electro-auto hoist for cable drag service. Exclusive features claimed include automatic operation of band type clutches, remote control, low digging speed and high inhaul speed, and high hourly and daily capacity. Essentially this hoist is a double-drum, two-speed hoist, high speed for the outhaul being secured by using a larger drum. The motor is a reversible slip-ring type. There is a separate brake for each drum so arranged that when one is on the other is off. Made in two size groups, the SGS-1, 2 and 3, with parallel drums, to handle scraper buckets of 1/3, ½, ¾, and 1 cu. yd.; size SGS-6, 7, 8, with tandem drums to handle scraper buckets of ½, ¾, 1, 1½, 2, 2½, 3 and 4 cu. yd. capacity.

The Novo Engine Co. announces a new heavy duty anti-friction hoist built in sizes of from 1 to 3 cu. yd. capacity for dragline scraper service. The front or inhaul drum is said to have a line speed of 200 ft. per min., while the rear or outhaul drum travels at 600 ft. per min. All bearings are of the anti-friction type and roller bearings are used on the drum and intermediate shaft drums. The power units have 75 to 125 hp. gasoline engines or electric motors. It also announces a slackline cableway excavator hoist arranged for slackline cableway work with two speeds on the front drum. A speed of 200 ft. per min. is provided for digging and 600 ft. per min. for inhaul. These hoists have a quadruple roller chain drive and one piece adjustable brake giving 280 deg. for braking surface.

The Ingersoll-Rand Co. announces two sizes of I-R slusher hoists. They are the 207 of 7½-hp. and the 210 of 10-hp. (Fig. 3), are said to be constructed essentially the same as the 15-hp. and 20-hp. sizes. Features claimed are: fully enclosed construction to protect drums, clutch and brake; brake lock; two-clutch, balanced

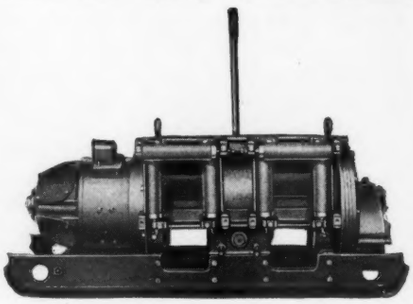


Fig. 3. Electric slusher hoist

drum drive, with single lever safety control; enclosed gear chamber with helical silent chain gears operating in a bath of oil; foot-controlled brakes; adjustable case hardened cable rollers mounted on Timken roller bearings; steel skid mountings; and accessible external motor. The Ingersoll-Rand Co. also announced the addition of a non-reversible single-drum electric hoist (Rock Products, December 5), and an addition of size HUL to its line of "Utility" hoists (Rock Products, August 1).

Jaeger Machine Co. announced a line of Timken roller-bearing single- and double-drum thrust hoists (Rock Products, February 14).

The General Electric Co. announces a new pendant type push-button for controlling small, floor operated, cranes, designed to supersede the present rope and chain types of control. Controller and push-button station is 20¼ in. long 2⅜ in. wide and 2 9/16 in. deep less the projection of the buttons. The box is of cast aluminum.

For the machine shop trolley hoists were announced by the Wright Manufacturing Co. (Rock Products, May 9 and August 15) and by the Yale and Towne Manufacturing Co., whose "Rail-Hugger," in capacities from 1½ to 10 tons, requires minimum head room.

In material handling equipment the Clark Tructractor Co. announced a new line of gasoline powered "Truclifts" and "Tructiers" (Rock Products, December 19). The Economy Engineering Co. announced a new line of ball-bearing equipped, hand and power operated lifting machines (Rock Products, March 14). The Howe Chain Co. announces its improved "Jak-Tung" truck for warehouse use, adapted for use as a hand truck or trailer. It is said to incorporate the advantages of the lift truck system with greater flexibility of operation.

Two electric trucks are announced by the

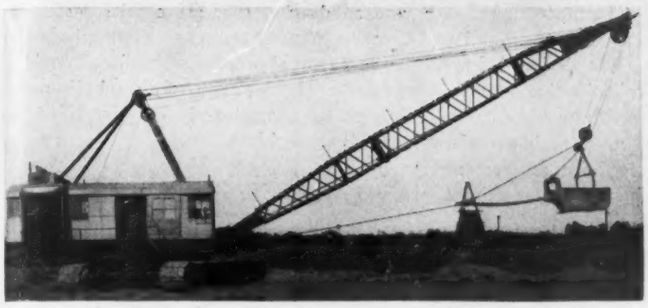


Fig. 4. Full air control Diesel dragline

Yale and Towne Manufacturing Co. Its "multi-lift" or telescoping truck is said to be so compact that it can pass through a 7-ft. doorway, pick up a 3000-lb. load and raise it to any desired height, up to 30 ft. headroom. The Yale "Midget" electric truck has an over-all width of 29 in.; the over-all length of the high and low lift models, with a standard load platform 42 in. long and operator's platform folded up, is approximately 80 in.

Excavating Machinery

Many new models of excavating machinery and equipment were announced during 1931. The Bucyrus-Erie Co. early in January, 1931, introduced a 3-cu. yd. Diesel dragline, a machine of medium size with full air control. In the spring of the year four new convertible excavators were announced, the chief difference being in size; each with gasoline, Diesel or electric power; the 32-B (Rock Products, August 1); the 37-B model (Rock Products, September 12). A new 1¼-yd. gas+air machine (gasoline engine prime mover, air for swing and crowd) was announced during the year. Two new quarry shovels were also introduced; the 52-B 2¼-yd. electric and the 42-B 1¼-yd.; both are convertible; designed primarily for use in small and medium size quarries. Early in the year Bucyrus-Erie introduced an improved type of tower excavator extensively used in the Mississippi flood control work. A major development announced by this company in 1931 was the 18-yd. stripping shovel (Rock Products, December 5). During 1931 Bucyrus-Erie announced the purchase of a controlling interest in the Monighan Manufacturing Corp., manufacturers of walking dragline excavators. (Fig. 4.)

Fig. 5. Gasoline or Diesel powered

An improved, full revolving 1-yd. excavator known as the "P. & H." was announced by the Harnischfeger Corp. (Rock Products, June 6). This company also announced a ⅜-yd. excavator known as model 200-A as described in Rock Products, September 12.

A new convertible power shovel, Model 17, full revolving, full crawler mounted was announced by the Keystone Driller Co. (Rock Products, April 25).

The Link-Belt Co. announced a new shovel crane dragline known as K-48 which ranges from ¾ to 2½ cu. yd. capacity (Rock Products, October 24).

A new ½ cu. yd. gas shovel was announced by the Marion Steam Shovel Co. (Rock Products, October 10).

An enclosed model shovel was announced by the Michigan Power Shovel Co. (Rock Products, November 21).

The Pontiac Tractor Co. announced a fully convertible, full-revolving ½ cu. yd. shovel (Rock Products, July 18).

The Austin Manufacturing Co. announced an 11 cu. ft. convertible shovel known as the "Badger" (Rock Products, November 21).

The American Hoist and Derrick Co. has just announced its new "American Gopher" shovel-crane-dragline 1932 model in ¾, 1, 1¼, 1½, and 1¾ cu. yd. sizes. These shovels may be had with gasoline or Diesel power and the manufacturer states they have all of the latest features. (Fig. 5.)

A new type of crawler and driving mechanism for the "Whirlwind," a ⅜-yd. shovel, the "Speeder 90," a 1¼-yd. shovel and the "Speeder B3," a ½-yd. shovel, all full-revolving and gas powered, was announced by the Speeder Machinery Corp. (Rock Products, April 25).

The Marion Steam Shovel Co. shipped a large aluminum dragline boom for use in Mississippi flood prevention work, which is one of the early applications of aluminum in the excavator field (Rock Products, August 1). Aluminum booms for dragline excavators were announced by Bucyrus-Erie Co.

The National Malleable and Steel Castings Co. announced a new chain for dragline service (Rock Products, April 25).

The Northwest Engineering Co. developed a hammerhead boom for steel erection (Rock Products, October 24).

Special equipment having application in the excavating field announced during 1931 include a new shoe-type, thrustor oil brake for alternating current motors announced by the General Electric Co. These are said to provide quick, cushion-like braking in either direction with either light or heavy loads, adjustable for braking torque over a wide range. They are useful on many crane applications, jogging within a fraction of an inch of hook travel as required. With a thrustor brake the manufacturer states the motor armature may be rotated when jogged as little as 1/20 of a revolution.

Some of the features claimed for these brakes are adjustable torque; positive braking in either direction; self-aligning brake shoes; motor-mounted brakes require no base for mounting and cannot get out of alignment; three simple, accessible adjustments; they will not burn out because of any adjustment possible on the brake; and time delay in setting up to 20 seconds or more if necessary can be provided.

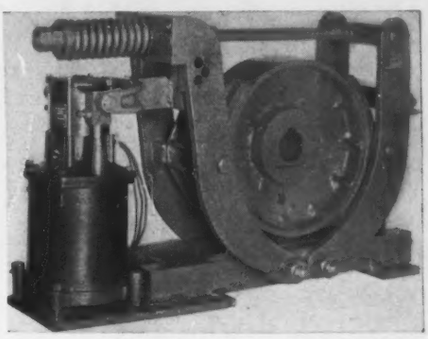


Fig. 6. Brake for alternating-current motors

Sauerman Bros., Inc., introduced a device to enable power drag scrapers to turn a corner along the span, and work along two paths at approximately right angles (Rock Products, August 10). This firm also announced a development which enables a crane or revolving dragline to operate a Sauerman "Crescent" scraper bucket (Rock Products, December 5).

Among the more important developments of Sauerman Bros., Inc., was the designing of several improved types of steel head-towers for drag scraper installations. These new towers are said to tend to increase the speed and ease of operation and the handling capacity of the large, mobile Sauerman scraper installations that are used by gravel and stone producers for storing and reclaiming materials and for stripping overburden. (Fig. 7.)

The new towers have been designed so that the overturning movement is resisted with an ample factor of safety, the manufacturer states, and yet the towers are not cumbersome in either appearance or action. The towers are self-supporting and self-propelling. For most projects, the tower is equipped with flanged wheels for travel on two lines of standard gage track, but crawler mountings are furnished when the ground conditions make crawlers desirable. A reversible propelling engine is mounted on the tower platform together with the scraper power unit. The operator's cab is on an elevated platform extending from the tower, the operated levers being banked in the cab.

Fig. 7. Self-propelling head tower

These towers have been designed in various heights and sizes to handle 2, 4, 6, 8, 10, 12 and 14 cu. yd. scraper buckets on 300 to 1000 ft. operating spans.

The F. M. Welch Engineering Service announces it has designed and built for the Medusa Portland Cement Co. a 36-in. by 160-ft. rotating, tilting and self-propelling stacker to dispose of stripping from a 3-yd. shovel. This stacker is said to handle about 300 cu. yd. of stripping per hour and, according to the manufacturer, the owner states that it will pay for itself through reduced cost of stripping disposal in approximately six months time. (Fig. 8.)

Bucket and Portable Loaders

For unloading bulk cement and other bulk materials from box cars not exceeding 4 in. in size the Barber-Greene Co. announced a new small bucket loader 7 ft. high, 6 ft. 9 in. long and 4 ft. wide (Rock Products, July 4). A crawler loader with helical ribbon type feeder and with cast-steel spiral which digs, lifts and conveys the material to the buckets, cutting a swath 7 ft. 7 in. was announced by the Link-Belt Co. (Rock Products, September 12), which also announced its new "Cub" loader for handling materials short distances or for loading (Rock Products, August 15).

Two new bucket loaders were announced by the George Haiss Manufacturing Co. The model 50, with a capacity of from 1½ to 1¾ cu. yd. per min., was designed especially for average stockpile loading requirements (Rock Products, August 1). The model 80 was designed as a high capacity loader and is claimed to have an average capacity in excess of 3 cu. yd. per minute (Rock Products, September 12).

A crawler type loader for handling sand, gravel and stone, with capacity of 2 cu. yd. per minute was also announced by the New England Road Machinery Co. (Rock Products, February 14).

Wire Rope

The only new development in wire rope or cables announced in 1931 was by the Broderick and Bascom Rope Co., which is "Flex-Set Pre-formed" construction. In this construction, the strand and wires themselves are pre-formed into a helix so that they fit snugly into the completed rope. According to the manufacturer this produces rope that is free of internal stress, is easily handled and installed.

Buckets

New buckets were announced by the Erie Steel Construction Co., the first a "hook-on" or "single-line" type of clamshell (Rock Products, June 20); and the other a new dragline bucket (Rock Products, August 15).

The G. H. Williams Co. announced improvements to its "Champion" clamshell bucket (Rock Products, July 18). Late in the year announcement was made that the clamshell bucket and heavy duty trailer business of the G. H. Williams Co. had been acquired by purchase by the Wellman Engineering Co. (Rock Products, December 19).

Sauerman Bros., Inc., during the past year designed and built "Crescent" scraper buckets for the first time in 12- and 14-cu. yd. sizes, thought to be larger than any bottomless scrapers previously built.

Car Doors

An announcement of particular interest to the cement industry because of the rapid increase in the use of bulk cement was made by the Hummel-Ross Fibre Corp. (Rock Products, September 12). Its H-R "Leakproof" grain door is said to eliminate the leakage of fine bulk materials at car doors and also simplifies the unloading problem.

Rail Transportation Equipment

Probably the most notable development in the transportation end of the business was a line of gasoline locomotives announced by the Lima Locomotive Works, Inc. The locomotives are built in two classes, 100- and 200-hp., and are of the mechanically driven four wheel type. Features of these locomotives are the drive, in which all chains, side rods and adjustable parts are eliminated and the gears comprising the transmission are on the outside; all shafts and axles are equipped with roller bearings and, like the gears, are completely enclosed and run in oil; three-point suspension; and a special air brake system which operates the brakes or cars having standard automatic air brake equipment directly in conjunction with the locomotive's own air brake. This company also perfected its "Shay" geared locomotives which are said to be 11% faster than rod locomotives on spotting work.

The Fate-Root-Heath Co. (Plymouth Locomotive Works) announced a light haulage locomotive equipped with Ford engines

Fig. 9. Gas- or oil-electric

and four-speed truck transmission (Rock Products, August 29). This company now announces three new models of Diesel locomotives, known as model FLD, 6-ton, equipped with a 3-cylinder, 36-hp. engine; model DLD, 8-ton, equipped with a 4-cylinder, 48-hp. engine, and model DLD, 10-ton, equipped with a 6-cylinder, 72-hp. engine. They have Cummins Diesels similar to the automotive type. According to the manufacturer the first model has been in service for several months at a fuel cost of 25 cents per 8-hr. day. The Fate-Root-Heath Co. also announces it has developed a line of gas-electric and oil-electric locomotives from 25- to 80-tons in weight. These locomotives have been designed by Plymouth engineers in cooperation with Westinghouse engineers. They are built in center-type high or low cabs or end type cabs with either double or single control stations and single or double power units. (Fig. 9.)

The Vulcan Iron Works announced three

Fig. 8. Disposes of stripping from 3-yd. shovel

new engines, the first a small Diesel locomotive operating on a 24-in. gage Decauville track (Rock Products, March 28); the second the "Vulcan Duplex," said to be the first locomotive of its kind built in America (Rock Products, August 29) to meet the demand for a fairly heavy steam locomotive by distributing the weight over a greater length of rail, thus making it adaptable to the handling of heavy loads on steep grades with sharp curves on poorly laid track; third a 50-ton, 8-wheel gas-electric locomotive powered with two 175-horsepower gasoline engines (Rock Products, October 10).

The Brookville Locomotive Co. announced a locomotive driven by a Ford model "AA" power plant (Rock Products, November 7). It now announces its BMD series, made in weights of 4, 5, 6, 8 and 10 tons. Power sufficient to slip all four steel-tired driving wheels on a dry sanded rail in both first and second gear is claimed, as well as a speed of 16 mi. per hour in high gear under governor control. Five speeds forward and reverse are provided in the BMD 8-ton and BMD 10-ton and four speeds in the BMD 4-, 5- and 6-ton models. Power is furnished by a McCormick-Deering gasoline combustion engine.

The Heisler Locomotive Works announced a 60-ton, 360-hp., oil-electric locomotive for switching and hauling in quarries around gravel pits and cement plants and other industrial operations where large tonnages of materials must be transported. (Rock Products, April 11).

The Ruth Co. announces a gasoline mine locomotive designed with minimum clearance for use in mines where good ventilation is available. This 18-in. gage mine locomotive is 31½ in. wide, 4 ft. 4 in. high and has a 10-gal. radiator. The overall length is 7 ft. 2 in. Braking surface of 300 sq. in. is provided. Gears and pinions are of alloyed steel. Shafts and Timken bearings run in a bath of oil. Five speeds in either direction are provided. A Ford model AA motor furnishes the power. This model is built in sizes of 2, 2½, 3, 3½, 4 and 5 tons and is said to give approximately 40% of its weight in tractive effort. (Fig. 10.)

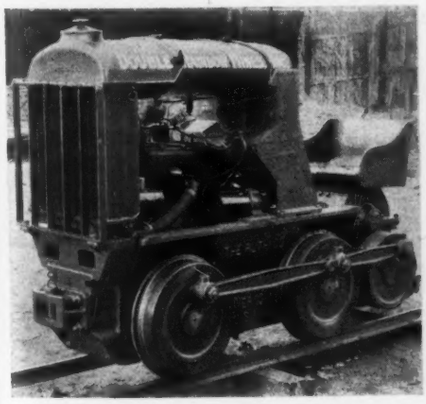


Fig. 10. For mines with good ventilation

Cars

The Differential Steel Car Co. announced a gas-electric dump car, a self-contained unit carrying its own power plant, intended for service in open pit mining and quarry work (Rock Products, August 15).

The only other development in quarry cars announced during the year was by the Woodford Engineering Co. which has adapted a large double truck drop door air dump car to its system of remote controlled electric railway. Each car is equipped with heavy duty street railway motors and complete electrical apparatus to enable the car to operate continuously over 6% grades and to be controlled entirely from the control towers and shovels. (Fig. 11.)

Anther interesting development of the Woodford Engineering Co. is a complete signal system in which the track layout is

Fig. 11. Adapted to remote controlled railway

divided into signal blocks, and signal lights in the tower show where all cars are at all times. One or two cars to a block are indicated. This signal system is said to be applicable to train operation.

Tractors and Crawlers

There was much activity in this field, many manufacturers reporting new and improved equipment. The Trackson Co. announces that its high shovel had been adapted to the Case-Trackson heavy duty tractor. It is claimed to be unusually flexible in its application and to operate efficiently on both light and heavy work. It has a high dumping clearance of 7 ft. and is designed so that the bucket is held close to the tractor. The bucket is controlled by one lever, raising in 10 seconds and lowering in 5 and has a lifting capacity of 3000 lb.

The Bucyrus-Erie Co. announced that it had taken over the sales of the "Loadmaster," a portable gasoline crane with a full revolving boom mounted on a crawler tractor. The Hercules Co. announced its "crawl tractor" which combines a tractor and road roller in one unit (Rock Products, November 21). The Shunk Manufacturing Co. announced its improved tractor dump wagon, the chief feature of which is a flexible front axle as standard construction on the "Camel" (Rock Products, August 1). A new model CD Case-Trackson crawler tractor was announced by the Trackson Co. (Rock Products, July 18). The Euclid Crane and Hoist Co. announced a crawler type hydraulic bottom dump wagon (Rock Products, June 6), also an 8-yd. crawler type dump wagon (Rock Products, July 24). The Foote Bros. Gear and Machine Co. announces the addition to its line of the Bates hydraulic bulldozer, built specially for use in combination with the Bates crawler type road tractors. La Plant Choate Manufacturing Co., Inc., announces a three-way dump wagon (Fig. 12) in capacity from 7 to 10 yd., with roadlayer tracks; also improvements to its roadlayer wagon (Rock Products, November 7). Model 6-28 F, a new Linn tractor, was announced by the Linn Manufacturing Corp. (Rock Products, January 31). The new and improved "Steel Mule" was announced by Marion Mules, Inc., with body capacity of 4 cu. yd. (Rock Products, January 31). The Bodinson Manufacturing Co., Inc., announces the "Bodie" clamshell dirt mover. The Trackson Co. announced new 15-ton "Trackson" crawler wheels (Rock Products, May 23), also a 7-yd. dump cart type crawler wagon suitable for heavy hauling (Rock Products, August 1).

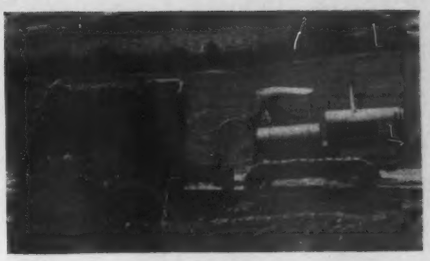


Fig. 12. Three-way dump wagon

Truck Delivery Equipment

A number of new developments in truck delivery equipment were announced in 1931. Increased use of aluminum in truck body construction is also shown.

A truck body to permit 3-way dumping was announced by the Diamond-T Motor Car Co. By means of levers in the cab the load may be dumped to right, to left or to the rear, and while the truck is in motion if desired. A double-acting tail gate is used and side gates may be opened slightly in rear dumping to free a sticky load. To facilitate manipulation of loaded trailers the Fager Six-Wheel Attachment Co. announced equipment which transfers the loaded body of the trailer to the truck dump body, from which it is dumped in the same manner as the loaded truck (Rock Products, June 20).

The Griswold Powermatic Corp. announced a power driven truck loading and unloading device to reduce loading and unloading time (Rock Products, February 28).

A new type of truck which, it is claimed, introduces for the first time the multi-motor principle as a means of developing power, hauling capacity and speed was announced by the Relay Motors Corp. (Rock Products, February 28).

A new rear four-wheel chain drive truck which, it is claimed, is the first motor truck

Fig. 13. Trailers are easily manipulated

developed that has pulling power in all four rear wheels with but one axle employed is announced by the Sterling Motor Truck Co.

The axle housing contains three distinct differentials. A large differential is said to divide the power equally between the two sides. On each side of the large differential and immediately adjacent to it, are two slightly smaller differentials. The right one divides power between the two right wheels and the left one divides the power between the left ones.

This gives perfect differentiation, it is said, to all wheels and accurately equalizes the drive regardless of tire variation in tire diameters or chain lengths.

Two axle shafts are employed. One is of the tubular type and operates one set of wheels, while the other is a straight shaft operating within the tubular one and pulls the other set of wheels. Six radius rods operating both longitudinal and crosswise hold the wheels in alignment.

Power is supplied with a 125-hp. six-cylinder Ricardo head engine. An auxiliary transmission giving 12 forward speeds is mounted amidship and is said to give the proper degree of power for every driving requirement.

Tests have been made where over 50 tons have been carried with the use of trailers and over varied road conditions. Pay loads up to 15 tons are carried with ease without trailers, it is reported.

The American Truck and Body Co., Martinsville, Va., developed a new demountable body trailer for handling clay or sand-lime brick which is made of both aluminum and steel. This equipment is also practical for handling sand and gravel and other bulk materials which are dumped. (Fig. 13.)

For handling sand-lime brick or concrete products the truck-trailer system has many advantages among which, the manufacturer claims, are, fleet of one truck and four trailers can handle 10,000 brick per trip; the brick are discharged in piles and not dumped.

The manufacturer states it has developed special bodies for different materials among which are sand, crushed stone, lime and cement.

Refractories

The most important development in refractories was made by the Corhart Refractories Co., Inc. It announced its "Corhart ElectroCast" which is claimed to improve performance of kiln liners by from 500 to 700%. The manufacturer states that a test has been run on the first installation of this material in a cement kiln for the past 14 months, which was a 6-ft. section in the severest portion of a hot-zone, and that in that time the original 5-in. thickness has been reduced but 2 in.

Harbison-Walker Refractories Co., in reviewing its 1931 developments, says that although no new product had been developed through the year progress through its research studies and improvements in its products by changes in preparation and method of manufacture have been made to improve the quality of its products. This company also reports its silica brick are now being made by machine under heavy pressure. This is said to have improved the physical properties of the brick. The company also reports improvements in its magnesite bricks which increase their life.

This manufacturer states that silica brick, used in the eyes and in those portions of the burning zones of shaft lime kilns where the temperature changes are not excessive, have in many cases more than trebled the service secured from any other refractory material.

Another noteworthy recent development in the use of refractories in the cement industry has been the general use of high alumina blocks or liners in the burning zone of rotary kilns. With harder burning of the clinker higher temperatures have become necessary and the point has been reached where a first quality fireclay brick formerly regarded as standard for burning zones, are not sufficiently refractory to meet the service conditions now imposed on them. The Harbison-Walker Refractories Co. announces there has been a marked improvement in the workmanship of fireclay refractories as a result of the introduction of the power press process and a study of the use of these presses to best advantage. This has resulted in notable improvements in its fireclay refractories. Improvements have also been made in its alumina refractories as a result of improved workmanship.

Washers

During 1931 there has been much interest in and a considerable demand for stone and gravel washing and scrubbing equipment and a number of developments were announced of such equipment.

The Allis-Chalmers Manufacturing Co. redesigned and improved its screw and log washers. On the sand screw washer steel plate casing of welded steel throughout is being used. On the log washers it has likewise standardized on steel plate construction with the log made up of standard sections and provided with renewable plates.

The Dorr Co.'s "Dorrco" sand washer was offered in four new sizes ranging from 7 ft. to 3 in. in diam. to 16 ft. in diam.; now made in capacities to handle from 40 to 300 tons per hour of concrete sand and from 250 gal. to 2000 gal. of water per minute. Improvements have also been made in mechanical features, particularly in introducing sand into the machine. The Dorr Co. reports that during 1931 more than twice as many of its Dorrco sand washers were sold than in any previous year. The Dorr Co. also announced a new type of mechanical classifier having an entirely new type of head motion (Rock Products, June 6).

The Stephens-Adamson Manufacturing Co. announced a mechanical classifier for washing and dewatering sand in large quantities (Rock Products, August 15).

The Eagle Iron Works announced that it had further improved its line of gravel and sand washers, and for large capacity requirements is building a double-screw washer, both in the gravel and sand washing type (Rock Products, March 28). It also announced the addition of two new standard sizes slightly larger than previously made as standard (Rock Products, July 18).

This company also has developed a new

Fig. 14. To classify sand from a flume

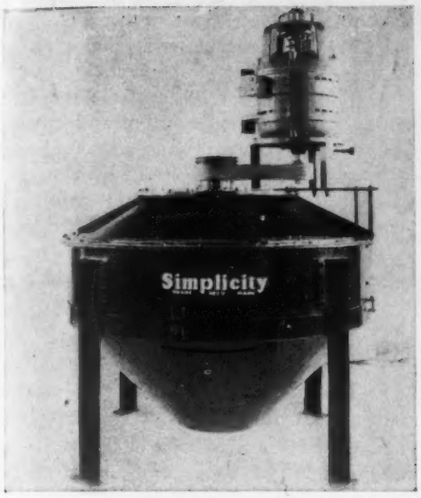


Fig. 16. To eliminate non-durable material from gravel

magnetically operated flume valve for sand classification said to be absolutely positive in operation. It is not dependent on any counterweight action to open the valve, and tests have shown that if necessary it will handle aggregate up to ½-in. in size, the manufacturer states. (Fig. 14.)

The valve is operated by electric solenoid. Another feature claimed is that the discharge is horizontal, allowing the gate in closing to cut into the discharge in a vertical plane and is said to permit the handling of larger material.

The new flume valve is made up in two parts connected by a rubber diaphragm. The upper chamber is stationary while the lower has a vertical movement governed by the weight of sand that has settled in it. The action is as follows:

When the lower chamber is depressed to a certain point the movement closes an electric switch which operates a magnetic solnoid, which gives a vertical pull to the gate over the discharge opening, which is spouted for side discharge at the bottom of the lower chamber. The solenoid holds the valve gate open for discharge until the switch is opened and current cut by the upward movement of the enlightened sand settling chamber. The gate is weighted and drops into place as soon as the current is cut and the pull of the solenoid released. Thus, by adjustment of the lever operating the switch, the flume valve may be made to discharge at whatever point is desired in the filling, and likewise may be closed wherever it works to best advantage in the emptying of the tank.

The "Simplicity D'centegrator" is announced by the Simplicity Engineering Co., (Fig. 16) designed primarily for eliminating non-durable material from gravel. This result is secured by breaking the material throught impact created by centrifugal force. through impact created by centrifugal force. After passing through the machine the gravel is screened to remove the fines which are said to contain the non-durable material.. This device is said to consist of less than 20 wearing parts of abrasive resisting material, all replaced at low cost per ton of material handled. A 15-hp. multi-speed motor with automatic push-button control supplies power to handle 100 to 150 tons of gravel per hour in the No. 36 D'centegrator, the manufacturer states. According to the manufacturer the D'centegrator can also be used as a secondary crusher, the only change required being a higher rate of speed.

The Kennedy-Van Saun Manufacturing and Engineering Corp. announces a neutralizer which was developed for washing stone. With this neutralizer, as the stone is being discharged from it a spray of water is thrown on the rock to rinse the neutralized clay from it.

The Deister Machine Co. reports that it has redesigned its cone baffle classifier to improve its operating factors.

A novel anthracite separator which may have application in the preparation of aggregates was announced by the Anthracite Separator Co. (Rock Products, January 17).

Magnetic Separator

A new "High Intensity" separator that makes magnetic separations heretofore impossible is announced by the Dings Magnetic Separator Co. It will separate such materials as slate from gypsum or coal, it is said. The manufacturer states it has been demonstrated satisfactorily on silica sand, feldspar, coal, gypsum and other materials where they have been mixed with supposedly non-magnetic iron compounds. The manufacturer states that it removes biotite, muscovite and pure oxide of iron from feldspar and silica.

Screens

In screens the most novel development is the roller bar screen announced by the Ross Screen and Feeder Co. (Rock Products, June 20), claimed to be immune from blocking, jamming and jarring with any material in whatever form it may be delivered; also claimed to be free of any crushing action; in its multiple form claimed to be used for washing operations.

Many improvements were announced in vibrating screens. The Allis-Chalmers Manufacturing Co. announced a number of improvements to its centrifugal vibrating screen, one of which is an improved type of suspension. New sizes in its one-, two- and three-deck vibrating screens were also developed, being 4 ft. by 10 ft., 5 ft. by 10 ft., and 5 ft. by 12 ft. sizes. The 5 ft. by 12 ft. double-deck screen is of the general type. A new three product vibrating screen for use with its Model 62 heavy duty bucket loader was announced by the Barber-Greene Co. (Rock Products, September 26). The Deister Machine Co. announces that it has made small improvements in the "Plato" vibrating screen. The Gifford-Wood Co. announces its improved "Mitchell" electric vibrating screen. This screen is totally enclosed, there being no visible parts. The principle of vibrating is unbalanced centrifugal force designed to transmit vibration to the screen cloth. The manufacturer states the amplitude of vibration is less than 1/16 in. in diam. but the force applied to vibrate the screen is approximately 2600 lb. A ¾-horsepower motor supplies the vibration force. The Deister Concentrator Co. says that refinements have been made to its "Leahy" screens to increase efficiency and economy.

The Robins Conveying Belt Co. announces improvements to its "Gyrex" screens. The fundamental change lies in the design of the spring suspension which now eliminates the use of shackles in any form and provides for the circular motion of the line frame by the means of transverse supporting springs at each end rigidly attached to ends of longitudinal springs. This is claimed to permit freedom of action but at the same time to maintain accuracy of position of motion along the actuating shaft and vibrator. Advantages claimed for this improved screen include a reduction in the number of parts and higher efficiency in operation, a smoother and quieter action and much simpler assembly.

A new model B "Simplicity" utility gyrating screen was announced by the Simplicity Engineering Co. (Rock Products, October 10). The manufacturer states that considerably more than 100 of these model B screens have been installed in screening plants since they were placed on the market.

The Stephens-Adamson Manufacturing Co. announced a new type of vibrator screen mounting (Rock Products, August 1).

The Traylor Vibrator Co. announced the development of the "Trayco Conveyanscreen" (Rock Products, April 25). The manufacturer claims this development produces more accurate sizing of materials.

The Kennedy-Van Saun Manufacturing and Engineering Corp. announces a roller bearing vibrating screen. There is a gyroscopic eccentric fly wheel attached to the shaft and the spreader sleeve which forms a housing for the Timken roller bearings between the housing and gyroscopic eccentric flywheel and places the load directly under the side frames. According to the manufacturer this eliminates all over turning and bending moment in the drive shaft. These screens are built in widths from 2 ft. to 7 ft. and having capacities from 10 tons to 1000 tons per hour.

Welding Pipe Fittings

Welding fittings for pipes were announced by two manufacturers. The Midwest Piping and Supply Co., Inc., announced fittings consisting of 90 and 45 deg. ells, heads, saddles and sleeves (Rock Products, September 26); the Taylor Forge and Pipe Works announced a complete line of seamless steel pipe fittings for welding fittings in all sizes to 24 in. inclusive (Rock Products, July 4).

Wire Screening

Two announcements on wire screening were made during the year. The Ludlow-Saylor Wire Co. announced that it had rounded out a full line of alloy steel woven screens in the coarse meshes suitable for service both as revolving-screen and as vibrating screen sections and for such other applications where screens are required for rough abrasive work (Rock Products, September 12).

The John A. Roebling's Sons Co. announces the development of alloyed steel screening for use where unusual abrasion is to be resisted. This new screen is known as Jersey "Abraso" EE spring steel which is said to be especially adapted for use on vibrating rotary shaking and gravity screens. This alloyed steel is made under a special process by the above company and is supplied in practically all specifications from 6¼ in. openings down to 18 meshes per lineal inch.

Crushers and Pulverizers

Novel developments announced during the year include a crusher which may be used either for granulating small stone or for breaking larger sizes, a change accomplished by shifting the main bearings and an adjustment in the block behind the toggle plate, by Mason Brothers (Rock Products, January 17); a centrifugal vertical impact mill by the Utility Mill Sales and Manufacture (Rock Products, October 24) and a crusher depending on impact of the rock against the outside casing (Rock Products, December 19).

The Traylor Engineering and Manufacturing Co. announces that during 1931 it has greatly improved its Type TZ reduction crusher (Rock Products, March 28). A rather unusual number of conversions of old type gyratories, utilizing the Bell Head and Concaves of the Type TZ machine are reported.

The Good Roads Machinery Co., Inc., announces that the No. 14 replaces the old No. 4 "Climax" crusher, and that many improvements have been made, including long jaw construction. The long crushing stroke, upper and lower fulcrum shaft bearings and the roller and eccentric bearings have been increased in size.

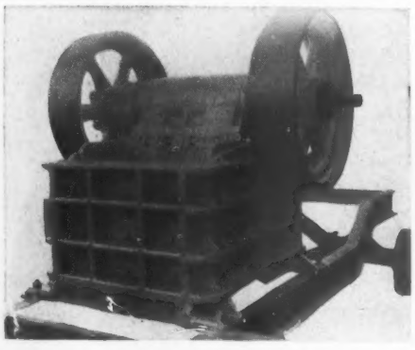


Fig. 18. Roller bearings a feature

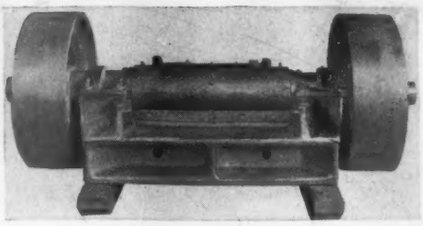


Fig. 17. Jaw reduction crusher

The Allis-Chalmers Manufacturing Co. announced the No. 248 fine crusher built to meet operating conditions not obtainable in other types of Allis-Chalmers jaw crushers. It also announced a new design of concaves for gyratory crushers (Rock Products, July 18).

The Smith Engineering Works announced a new Telsmith cone crusher guaranteed in the three vital parts against nearly all forms of breakage (Rock Products, April 11); also the Telsmith-Wheeling jaw crusher developed from the Wheeling jaw crusher which Smith Engineering Works acquired in 1930 (Rock Products, May 23).

The Sturtevant Mill Co. announced an improved and new ring-roll mill which is claimed to grind either hard or soft substances with equal efficiency (Rock Products, March 14). In coal pulverizing equipment the Fuller-Lehigh Co. announced a pulverizer for use in plants requiring relatively small amounts of pulverized coal (Rock Products, August 1).

The Dixie Machinery Co. announces that during 1931 it improved its hammer mill so that when crushing pure clay, regardless of moisture content, the power requirements have been reduced 50% per ton of ground material.

The Kennedy-Van Saun Manufacturing and Engineering Corp. announces the No. 73 and No. 85 ball bearing gearless crusher. The head and shaft of this crusher are suspended on a nest of springs and these springs are supported on the top and bottom by spring cage seats which are drawn together with spring cage bolts. These are set by hydraulic pressure to a given resistance so that no action of the spring is required until a strain greater than the hardest piece of rock is imposed at the bottom. The manufacturer claims this crusher will get a sizing efficiency of from 85 to 98%.

A new jaw crusher is announced by the Iowa Manufacturing Co.; a 3x36-in. reduction crusher with features claimed to include extra large phosphor bronze bearings, special heat-treated chrome eccentric shaft; base and pitman made of electric cast steel, and all wearing parts made from either special cast alloy or high carbon cast steel. (Fig. 17.)

A roller-bearing crusher of the jaw type, which the manufacturer claims will increase output with vibrationless operation, is announced by the Wisconsin Foundry and Machine Co. The frame of this crusher is low and deeply ribbed. The shaft is of large diameter and is made of alloy steel. Timken roller bearings are used. Advantages claimed for this crusher are low power requirements, smooth operation, low upkeep and large production. (Fig. 18.)

Pumps

Several new pumps were announced during 1931, but no new principles were involved in these developments. The Allis-Chalmers Manufacturing Co. announced an extension to cover three new sizes in its line of "SSU" centrifugal pumping units (Rock Products, February 14). A new manganese steel pump for abrasive materials was announced by the American Manganese Steel Co. (Rock Products, August 29). A portable pneumatic sump pump was introduced by the Chicago Pneumatic Tool Co., said to operate with equal efficiency whether partly or totally submerged and to require no priming. The Cleveland Pneumatic Tool Co. also announced a portable centrifugal sump pump (Rock Products, December 19).

A centrifugal pump for liquids carrying solids was announced by the De Laval Steam Turbine Co. (Rock Products, August 15). This company also brought out the De Laval balanced suction series pump, which makes it possible to connect two or more independent single-stage pumps in series to handle heads higher than those practical for a single-stage centrifugal pump. With this arrangement the manufacturer states the hydraulic self-balancing property of the double-suction single stage pump can be retained although the cross connecting pipe introduces some additional frictional surface and involves extra space and cost. The casing of this pump is split horizontally in the plane of the axis of the shaft making the internal parts accessible upon lifting the casing cover and removable after loosening

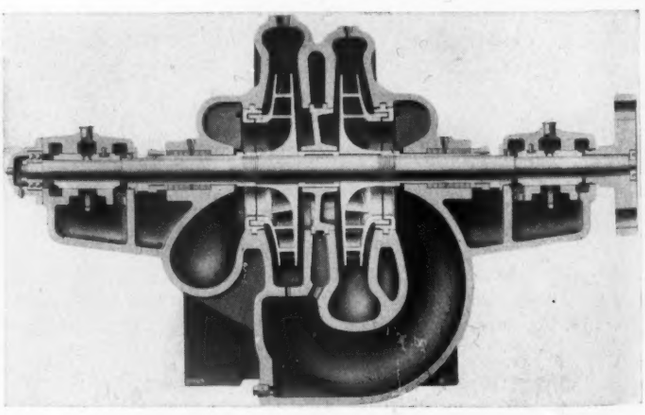


Fig. 19. May connect in series to increase head capacity

the bearing caps without disturbing the piping connections which are in the lower part in the case. (Fig. 19.)

The Ingersoll-Rand Co. announced that a number of new sizes had been added to its Cameron line of small general service centrifugal "Motorpumps" (Rock Products, December 19).

Improvements announced to its material handling pumps by the Morris Machine Works include new type bearings of the anti-friction type to its medium duty and heavy duty pumps for sand and gravel and for dredging service. Also the sub-base of these pumps has been stiffened and provides more substantial support for the pump casing in order to prevent vibration, the manufacturer states. Two new alloys have been developed for use in its abrasive materials handling pumps, "Flintmetal," a hard iron, is said to be specially adapted to handling fine abrasive. "Flintalloy" is a steel mixture said to meet the various requirements of a metal when handling the larger abrasive solids. Improvements which have been made on Morris water pumps and new designs of these pumps which have been developed apply particularly to the supply of water for screens in gravel plants, crushing plants and for general purposes.

The Worthington Pump and Machinery Corp. announced the Monobloc type D centrifugal pump, which is bolted to the extended motor frame (Rock Products, August 29). It also announced a new movable type D centrifugal pump (Rock Products, November 7).

The Novo Engine Co. announces new sand and gravel pumping outfits which are direct connected units consisting of an improved design, medium duty dredging pump and a four-cylinder engine mounted on an electrically driven steel base. There are three sizes of standard outfits, 4-in., 6-in., and 8-in. of 14, 31 and 56 cu. yd. capacity per hour respectively on a basis of 10% solids. Their total head, including friction, is 90 ft. The pumps are regularly supplied with the discharge in a vertical position as shown, but the casing on the 4-in. and 6-in. size can be swung around in other positions if desired. (Fig. 20.)

The Pennsylvania Pump and Compressor Co. announces a line of multi-stage centrifugal pumps, class "OMS" and "OMSB," said to make possible operation against higher pressures than is practicable with single-stage centrifugal pumps. This is accomplished by using two or more impellers in a single casing with the impellers arranged to operate in series. Multi-stage centrifugal pumps are now available for pressures up to approximately 1600 lb. per sq. in. Among the advantages claimed for these units are low maintenance, continued high efficiency, small floor space, noiseless operation and long life.

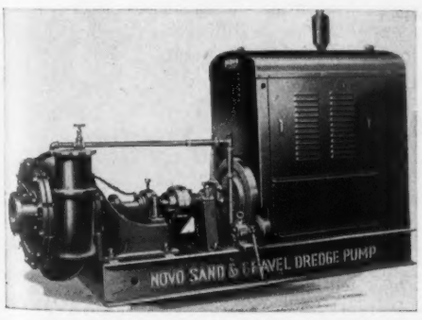


Fig. 20. Direct-connected dredge pump

The Sterling Machinery Corp. announces a new 2-in. model EL automatic positive priming centrifugal pumping unit, said to have a capacity of 9240 gal. per hour at 10 ft. head. This unit is said to pump air or water or a mixture of air and water and that it will pick up water as soon as seepage accumulates. The engine is of the vertical single-cylinder air cooled 4-cycle type developing approximately 1½ hp. at 1800 r.p.m. The pump is Timken bearing equipped.

The Petroleum Heat and Power Co. announces three models of oil pumps. The Petro-NoKol industrial belt drive pump is said to meet the needs of present day industrial power plants. It consists of a motor transmission mounted on a heavy iron base. Petro-NoKol domestic wall pump is designed for installations where fuel oil is fed the burner by static pressure created by a column of oil and consists of a motor connected direct to a pump and an integral iron casting which forms a constant level chamber and mounting bracket. These pumps are available in sizes rated at 10 to 20 gal. per hour. Its third unit is the Petro worm drive pump and consists of a motor, speed reducer and oil pump mounted on a heavy base. (Fig. 21.)

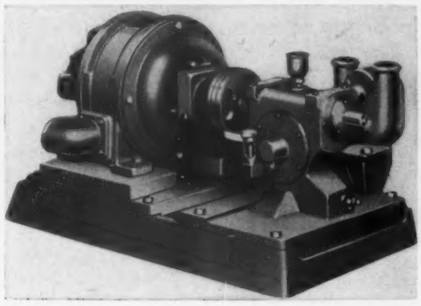


Fig. 21. Worm drive industrial oil pump

Dredges

Two improvements to its Eagle "Swintex" were announced by the Eagle Iron Works in 1931 (Rock Products, August 1). Hetherington and Berner, Inc., announced a fireproof, low maintenance cost structure for dredging machinery of the pontoon type (Rock Products, October 24). An appliance which may be connected to the disc line of a sand and gravel pump and said to accurately determine and indicate the percentage of solid materials in the flowing fluid was introduced by the Hydraulic Scale Co. The development (Fig. 22) includes a dial gage which reads directly in weights or in percentages so that the operator may be continually informed of the consistency of the material flowing through his pipe line. The American Rolling Mill Co. announced a line of spiral welded pipe manufactured in jointless lengths up to 40 ft. (Rock Products, July 4). The Maddox Foundry and Machine Co. announced it had completed an all steel self-propelling clamshell bucket dredge for reclaiming sand in water 100 ft. deep (Rock Products, February 14).

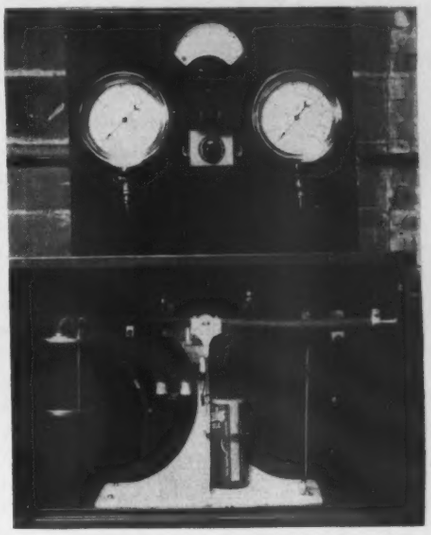


Fig. 22. Registers solids in pipe lines

Conveyors

The "Belt Trainer" designed to train the return strand of conveying belts was an interesting development by the Robins Conveying Belt Co. (Rock Products, October 10). The Stephens-Adamson Manufacturing Co. announces revision of a number of its standard conveyor and transmission units to increase operating efficiency and decrease production costs.

An apron type bin gate to provide an inexpensive and easy opening gate for large openings was announced by the Stephens-Adamson Manufacturing Co. (Rock Products, November 21).

A new hot material conveyor belt said to have a high heat resistance is announced by the Diamond Rubber Co., Inc. Distinctive features of the new belt are said to be its cover and friction compounds. The manufacturer states that at temperatures around 200 deg. F. these compounds maintain their rubbery and abrasive properties. This belt is made in the regular "Diamond flat-plied edgetied" construction. While this conveyor is claimed to be suitable for handling materials around 200 deg. F. it should not be used, the manufacturer states, where temperatures will at any time reach a maximum of more than 250 deg. F.

Pneumatic Conveyor

A pneumatic transport system for pulverized materials was announced by Kennedy-Van Saun Manufacturing and Engineering Corp. Transportation is produced partially by extrusion of an air saturated mixture and partly by pneumatic impulse in the transportation line, it is claimed.

Feeders

Several new feeders were announced in 1931 but the most interest centered in apron feeders. The "Amsco" feeder was developed by the American Manganese Steel Co. (Rock Products, December 5). A new design of manganese-steel apron feeders for heavy duty service suitable for handling abrasive or non-abrasive material containing lumps of ¼ in. in size or smaller up to 6 ft. was announced by the Link-Belt Co. (Rock Products, May 9). The Robins Conveying Belt Co. announced an affiliation with the Kensington Steel Co. whereby the Robins company has exclusive sales rights for the heavy manganese steel apron feeder patented by the Kensington company (Rock Products, September 12). Other types of feeders announced during the year include the "Concenco" disc feeder developed by the Deister Concentrator Co. for feeding crushed and ground materials up to 3 in. (Rock Products, October 10). A rotary feeder was announced by the Fuller Co. said to have a capacity range sufficient to cover all of the normal requirements of the rock products industry (Rock Products, August 29).

The Huron Industries, Inc., has a new type of feeder for raw mix and pulverized coal with which the rate of feeding can be determined and maintained indefinitely or can be changed to meet operating conditions. Advantages claimed for this feeder are that fluctuations in the consistency of the mix are not transmitted to the burner pipe and that arching or bridging over is prevented. It is also claimed that flooding is eliminated. Each feeder consists of a receiving box, a feeding box, three gear driven conveyor screws and a discharge box. The conveyors are said to be designed so that sufficient material is conveyed to the feeding box to keep a continual supply in the bottom of the box from which it is conveyed to the discharge box by means of a screw. These feeders are made in three sizes with 6-in., 9-in. or 12-in. conveyors. (Fig. 23.)

Weighing Devices

Much interest centers in automatic weighing devices and three new developments were announced in this field during 1931.

A constant weight feeder designed to operate over long periods of time under severe operating conditions with but nominal attention was announced by the Hardinge Co. (Rock Products, November 21). Improvements wherein the feeder has been used as a liquid proportioning device so that any change in the weight of the dry feed would also regulate the quantity of water, or other liquid being introduced at the same time, are announced.

The "Robotized" conveyor scale is announced by John Chatillon and Sons, which employs an electric "eye" to totalize the weight of material transported. An accompanying illustration shows this equipment as furnished to control and weigh the coal fed to stokers. The photo-electric unit is employed in conjunction with an ingenious development of the scale manufacturer to convert electric impulses into pounds, barrels, long, short or metric tons. This scale is said to be positive and instant in operation and weigh beam and levers are not employed as prime movers for any devices. The weight on the scale is electrically transmitted to a register, to an indicator or a recorder or a combination of any two or three instruments. Positive automatic control may be had with the telepoise scales which will prevent a down-spout, hopper or bin from overflowing or from being emptied. Among the advantages claimed for this device are that it eliminates parts subject to wear and that it eliminates adjustments and replacements. (Fig. 24.)

A new design in automatic hopper scales was announced by the Libra Scale Works (Rock Products, October 24). This scale is claimed to be adaptable to mixing purposes, as large or small weighings can be done on one machine.

With the rapid increase in the use of bulk cement the announcement by the Richardson Scale Co. of an automatic scale for weighing bulk cement is of interest (Rock Products, August 29).

A "Weightograph" claimed to be the only electrical illuminated weighing device on the market was announced by the Howe Scale Co. (Rock Products, April 25); it may be attached to the beam of any scale.

A laboratory scale was announced by the Toledo Scale Co. designed particularly to permit close reading without the use of extended beam equipment (Rock Products, August 29).

Prime Movers

Several combustion engines were reported by manufacturers. Also of interest because of the increasing availability of natural gas in many sections of the country is the natural gas engine manufactured by the Charter Gas Engine Co. (Rock Products, July 4). The Continental Motors Corp. has announced a new series of 6-cylinder L-head engines designed for high speed and performance but of comparatively light weight (Rock Products, June 6). The Hercules Motors Corp. announced an additional line of heavy duty 6-cylinder L-head engines designated as Series JX (Rock Products, May 9); also announced a line of small 4-cylinder engines and power units designated as the Hercules IX Series (Rock Products, Oc-

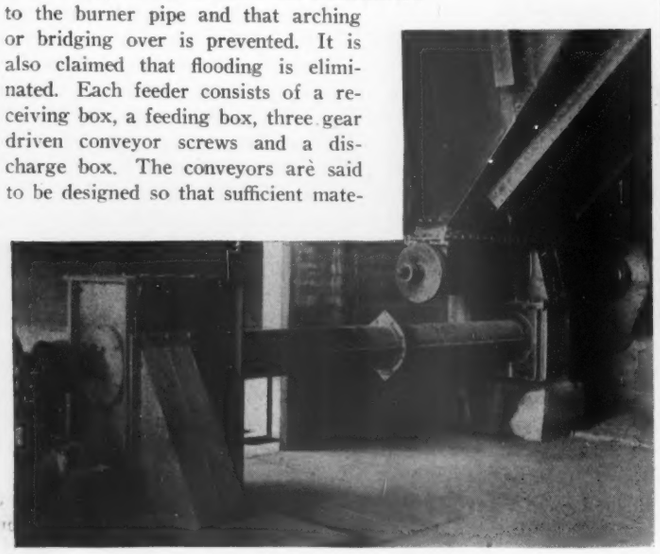


Fig. 23. Determines and maintains rate of feeding

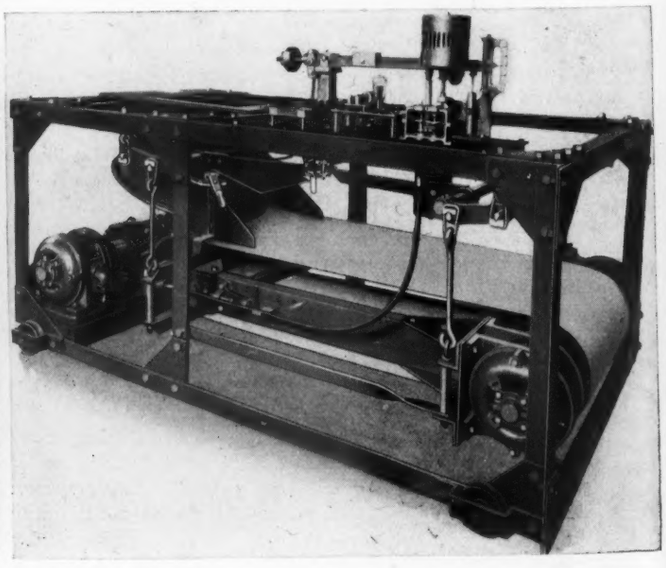


Fig. 24. Electric eye totalizes weight of transported material

tober 24). A slow speed engine of the heavy duty type was announced by the Linn Manufacturing Co. (Rock Products, May 23).

The most recent announcement is of a 10- to 14-hp. Model NNU gas engine by the Novo Engine Co. It has a high compression head, 3-bearing crankshaft and is equipped with two Timken and New Departure ball bearings. The cylinder block is cast of a chrome-nickel alloy.

The Waukesha Motor Co. introduced a series of two small 4-cylinder engines of 10 to 20 hp. (Rock Products, September 12).

Auxiliary equipment announced during the year consisted of an oil type air cleaner announced by the United Air Cleaner Corp. (Rock Products, July 4), and a new development in carburetion announced by the Northwest Engineering Co. (Rock Products, August 29).

Power Plants and Accessories

One new boiler was announced during 1931, and a new waste-heat boiler. In addition there was a rather large number of power plant accessories, improvements over present products and designs rather than radical new developments.

The Combustion Engineering Corp. has a new type of boiler; the salient features claimed are its new tube arrangement and steam liberation. The tubes in the first pass of the boiler are arranged so that half of them enter the front drum and half enter the middle drum. The tubes in the second pass are arranged so that half the tubes enter the middle drum and half enter the rear drum. This boiler is available in sizes ranging from 2000 sq. ft. to 26,000 sq. ft. of heating surface. It is adaptable to any type of firing and may be set double.

The Babcock and Wilcox Co. announced a new waste-heat boiler known as the B & W "three-drum," said to be especially adapted for the utilization of waste heat in the cement industry (Rock Products, April 25); also a new insulating fire brick (Rock Products, August 29). Another development of this company was a metal gasket primarily for use in making connections between the ends of economizer tubes and the return bend fittings (Rock Products, November 21).

The Bailey Meter Co. announces several new devices to improve the efficiency of power plants. Most important is a three-element feed water control system designed to provide a quick acting feed water control system. The three elements are steam flow from the boiler, feed water flow to the boiler and water level in the boiler drum. The control is based on metered results. A combined record for feed water control and boiler water level and an adjacent record for boiler steam flow supplies complete operating information for boilers, which require careful feed water control. The three elements are co-ordinated to operate a Selsyn sending device through a torque amplifier. The coordinating linkage of these three elements may be adjusted so that the water level in the drum is permitted to vary during normal operation in accordance with the "swell" in boiler rating. The Selsyn method of electrical transmission is used as the connection between the flow meters, which are the primary source of control, mounted on the panel board and the regulating valve. The Selsyn hydraulic feed water control valve is provided with its own motor driven oil pumping unit mounted directly on the valve.

Another development of the Bailey Meter Co. is the relay pressure valve designed to give accurate pressure control of steam, water or gas lines. (Fig. 26.) The relay valve controls the pressure within close limits by regulating the movement of a sylphon operated or piston-operated throttle valve installed in the line in which the pressure is to be controlled. A minute change in the controlled pressure will result in a relatively large change in the motive pressure used to operate the regulating valve, the manufacturer states. A distinctive feature claimed for this valve is an adjustable seat gap which can be adjusted by means of a micrometer adjusting nut. This adjustment makes it possible to obtain any desired speed in its amplified pressure connection. These valves may be used to operate one valve, a series of valves or pistons. This company also announced two new valves, one a boiler-feed pump governor and the other a control valve (Rock Products, March 14); also equipment to enable test water samples cooled to room temperature under pressure to be made (Rock Products, June 20).

Another development of this company during 1931 is the Bailey coal meter to measure coal or other granular material in gravity chutes from overhead bunkers. This coal meter is said to give a reliable check upon the amount of coal delivered to each stoker in hundred pound units.

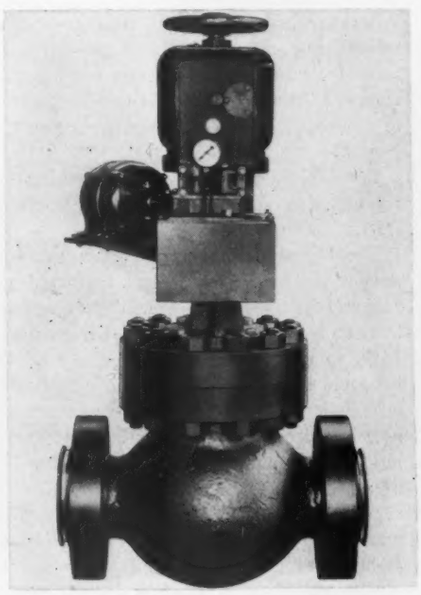


Fig. 25. Steam flow control

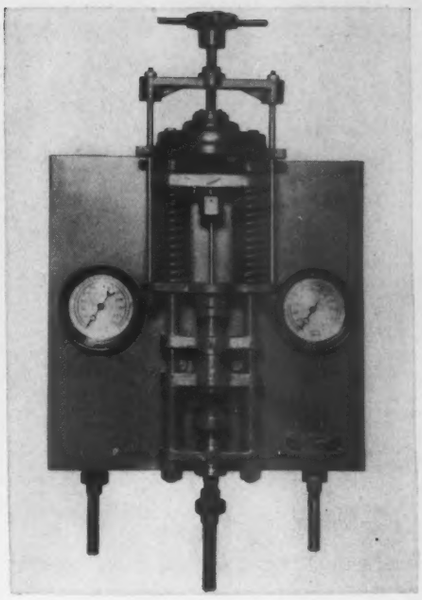


Fig. 26. To control pressure of steam, water or gas

Another development is Dieform compression fittings and tubing available for small service lines in the power plant and industrial field (Rock Products, May 23).

The Combustion Engineering Corp. announces its C-E electric stoker drive for Type E and Type K stokers, Fig. 27.

A new product known as "Rubber Crimps" or "U" type hydraulic packing for service on hydraulic rams and presses was announced by the Diamond Rubber Co. (Rock Products, August 15).

The Metalastic, Inc., announced that its packing, "Metalastic," is available in coil form (Rock Products, April 25).

A development in industrial oil burners is announced by the Petroleum Heat and Power Co. Its Model "W" oil-burning systems are said to provide increased operating efficiency, fuel economy, capacity, quick steaming ability, flexibility of operation, life of boiler and brickwork, conservation of heating values and valuable saving in space and elimination of smoke nuisance. The Model "W" is produced in capacities to care for maximum boiler horsepowers of 60, 75, 100, 125 and 175.

The Her-Born Engineering and Manufacturing Co. announced the "Blomatic" which is claimed to prepare coal and fire boilers automatically (Rock Products, January 31).

The Holbeck Direct-Firing Unit Corp. announces a direct firing unit for small size pulverized coal equipment. It is made in sizes from 9-in. to 18-in. and up with capacities from 50 lb. per hour to 25 tons per hour, claimed to be fully automatic. The conveyor takes coal from the bin to

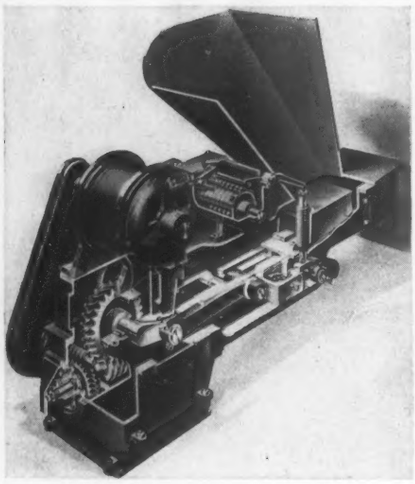


Fig. 27. Electric stoker drive

the unit. There are no grinding parts. It uses slack coal, operates intermittently under four Mercoid automatic switches and one unit will fire any number of boilers up to the capacity of the unit.

The Meriam Co. announces a new instrument known as its high range manometer Model 391, designed to provide a portable instrument for checking the accuracy of flow meters. The standard instrument is 42 in. high, 6 in. deep, 4½ in. wide and it weighs approximately about 20 pounds.

The Diamond Rubber Co. announced a new rubber matting for use as a safety insulator for operating power switchboards. It is guaranteed to withstand 15,000 volts under the voltage test and 40,000 volts under the dielectric test prescribed under the American Society for Testing Materials.

A new gasket material, said to be moisture-proof and highly oil-resistant is announced by the General Electric Co. This material known as No. 1000 compound is recommended by the manufacturer for applications where the primary purpose of the gasket is to exclude moisture.

The Diamond Rubber Co. also announces a new grade of asbestos sheet packing intended for use with hot oil under standard compression tests and pressures of 40,000 to 45,000 lb. are required to make the new packing fail. An immersion test in kerosene shows it is a superior packing, the manufacturer states.

A protective coating for preventing corrosion of power plant equipment was announced by the Dampney Co. of America (Rock Products, December 19).

The Quigley Co., Inc., announced "Hydro Seal" a product to seal thread, flange and gasket joints in lines carrying water, artificial and natural gas, air and low pressure steam (Rock Products, August 1).

A liquid protective coating was announced by the Liquilox Co., Ltd. (Rock Products, September 12). This coating is said to protect against all acids, alkalies, salts and miscellaneous destructive forces.

Power Transmission

An interesting development in power transmission equipment was made by the Rockwood Manufacturing Co. (Rock Products, July 18), a new short center drive for leather belts. Since first announced improvements and refinements have been made to fit the load requirement of the driven machine easily; the adjustable arms adapt the drive to all motors and when the exact load of the driving machine is guessed at, the "Rockwood" drive will not only tune the motor to the work but also measure the load, it is claimed. (Fig. 28.)

Another interesting announcement is the floating motor drive developed by the Kritzer Co. (Rock Products, May 9), designed so that the driving motor "floats" on the load.

A recent development in flexible couplings is announced by the F. A. B. Manufacturing Co. According to the manufacturer the new coupling, in addition to compensating for the parallel and angular misalignment, embodies a shock resisting feature and method of eliminating shock vibration. The manufacturer states that no lubrication is required and claims that the improved coupling will operate noiselessly at 3450 r.p.m. It is manufactured up to sizes 1200 hp. An accompanying illustration shows this coupling in a cement mill on the Pacific Coast. (Fig. 29.)

The Robins Conveying Belt Co. during 1931 acquired manufacturing and sales rights to the Robins-Jones bearing, an anti-friction bearing which is claimed to furnish a constant and uniform microscopic film of oil (Rock Products, May 9).

A special bearing enclosure designed for its cement mill machinery was announced by the F. L. Smidth and Co., which, it is claimed, will provide proper lubrication of ball or roller bearings operated at high speeds (Rock Products, April 25).

Sprout-Waldron and Co. announced a new self-aligning pillow block to meet the demand for a rugged anti-friction bearing suitable where loads exceed those ordinarily met in lineshaft service (Rock Products, June 6).

The Cincinnati Rubber Manufacturing Co. announced a new endless belt, "Flexicord" (Rock Products, September 26).

The Diamond Rubber Co. announces that during the past year it has improved the rubber frictions for "Diamond" transmission belts so as to increase the initial friction pull 13%, to improve the ageing quality of the belt, and to increase its resistance to flexing on small pulleys 65%. It also announces a new belt dressing for rubber belts. According to the manufacturer, this new rubber belt dressing contains no oil or grease or no chemicals harmful to belt or pulley. The manufacturer states that it is not inflammable, it retains its tackiness for a long period and it more than doubles the pulling power of the belt.

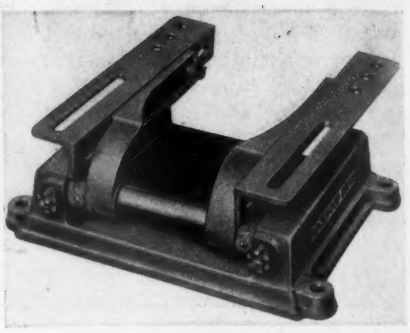


Fig. 28. Adjustable arm motor bases

A new type of pressed steel "Texrope" sheave was announced by the Allis-Chalmers Manufacturing Co. (Rock Products, July 4). Lukenweld, Inc., announced it is manufacturing all welded rolled steel gear blanks for use in the manufacture of gears (Rock Products, November 7).

The Philadelphia Gear Works announced the development of a line of welded steel gears ranging in diameters from 15 to 168

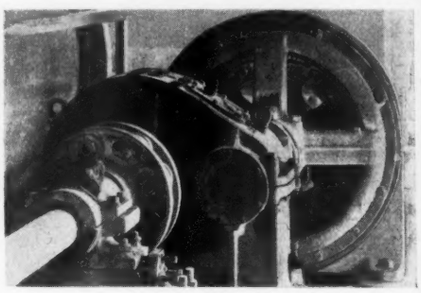


Fig. 29. Flexible couplings

in. and said to be especially adapted to heavy duty service (Rock Products, June 6).

A flexible shaft coupling for fractional horsepower drives was announced by the American Flexible Coupling Co. (Rock Products, December 19).

A machine base designated to reduce sound and vibration transmitted by machinery through its base was announced by the United States Gypsum Co. (Rock Products, December 5).

Speed Reducers

Many new speed reducers were announced during 1931. The most unique is the electro-hydraulic transmission announced by the American Engineering Co. This equipment provides for power transmission from an electric motor to a hydraulic motor, the speed of which can be varied from zero to maximum in either a forward or reverse direction by a hand wheel (Rock Products, September 12).

The only other variable speed equipment announced not based on various types of gear control was made by the Reeves Pulley Co., an enclosed model of its variable speed transmission (Rock Products, July 4). This company also announced a new type of unit directly mounted on the motor shaft which

drives direct to shaft pulley (Rock Products, August 15).

The Cleveland Worm and Gear Co. recently announced an addition to the series of

Fig. 30. Made in both horizontal and vertical types

worm reducers which is designed to transmit up to 7½ hp., the capacity depending on the reduction ratio and worm speed. The new size is furnished in both horizontal and vertical types in a range of nine standard ratios varying from 4 5/6:1 to 60:1. Fifteen special ratios are also available. (Fig. 30.)

A line of worm reduction gears with roller bearings on the gear shaft to supplement its previous line of worm reduction gears with plain sleeve bearings on the gear shaft is announced by the De Laval Steam Turbine Co. The casings have been redesigned to make them stiffer and stronger and present a larger surface for the dissipation of heat. The new line of reducers is built in all ratios from 4 to 1, in single reductions, up to 8000 to 1 in double reductions.

A series of gear units suitable for speeds up to 6000 r.p.m. and for powers from 120 to 2500 hp. with ratios up to 10 to 1 for either increasing or reducing speed was announced by the Farrel-Birmingham Co., Inc. (Rock Products, November 7).

Two new reducers were announced by Gears and Forgings, Inc. A two-speed worm gear reduction unit with which speed can be

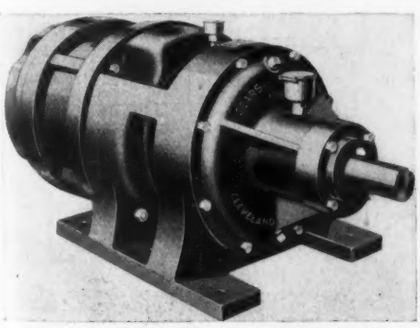


Fig. 31. Planetary reducer integral with motor

changed while the unit is in operation and under full load was recently announced (Rock Products, October 24). The company now announces a speed reducer of the planetary type built integral with an electric motor. No additional loads are imposed on the motor shaft, which is supported by two ball bearings, the manufacturer states. This type of speed reducer is built in 34 standard ratios in sizes ranging from ¼ hp. to 30 hp. (Fig. 31.)

The Horsburgh and Scott Co. announced a line of two worm gear speed reducers in the smaller sizes. Advantages claimed for these worm gear reducers are that the worm is forged integral with the shaft; worm threads are hardened to glass-hardness; and that perfect alignment of worm and gear is provided by Gurney radial thrust bearings on worm shaft and Timken bearings on the gear shaft.

The D. O. James Manufacturing Co. announced a speed reducer of the vertical spiral bevel type (Rock Products, May 23).

Two new speed reducers were announced by the W. A. Jones Foundry and Machine Co. A new series of small Herringbone-

Fig. 32. Available up to 250 hp.

Maag reducers was announced early in the year (Rock Products, July 18). Later a series of three worm speed reducers for small electric drives up to 7 hp. capacity was announced (Rock Products, November 7).

The Watson-Flagg Machine Co. announces a complete line of slow speed motor drive units comprising high speed motors with integral helical reduction gears. Features claimed for these units are positive drive, anti-friction bearings throughout, simplicity, compactness, overhung loads, and easy installation. Units of this type are available in combinations with motors up to 250 hp. and can be supplied in speed ratios up to 1800 to 1. (Fig. 32.)

Cement Mill Machinery

Most of the development in cement mill equipment during 1931 has been in new applications rather than new products. Indicative of increased acceptance of closed-circuit grinding of raw materials, in the wet process industry, is the second installation of the Dorr Co., Inc., at the Pittsburgh Plate Glass Co., Columbia cement plant, which was made in 1931. This installation is somewhat larger than the initial one at the Dewey Portland Cement Co's. Davenport, Ia., plant, and differs in that the raw grinding is carried out in two stages in primary and secondary mills instead of two stages in compartment mills.

The manufacturer states that the installations made to date are showing an appreciable reduction in the unit cost of raw grinding and that the product appears to display improved burning qualities.

Filters and Clarifiers

Two developments in filters introduce new principles in this field. Most recent is the oscillating continuous filter announced by the Bartlett Hayward Co. (Rock Products, December 5). Increased efficiency in drying, in rate of drying and ease of maintenance and repair are the most interesting features claimed for this filter.

Combination of its vacuum continuous filter with a recirculating air dryer that utilizes waste heat from the kiln was announced by Filtration Engineers, Inc. (Rock Products, June 6). The advantages claimed for this system are that it reduces or eliminates mud rings and spill backs and that the clinkering zone is moved back in the kiln.

Also of interest is the Hardinge rectangular clarifier, made by the Hardinge Co., which has found its first application in the treatment of sewage sludge. This clarifier consists of a traveling carriage similar to the standard bridge crane. From this is suspended the structure which supports the scraping blade, which moves over the bottom of the tank and scrapes the material which has settled on the bottom to a hopper at either end or in the center, as may be desired. On the return stroke, or when the carriage goes away from the hopper, the scraping blade is automatically lifted to a hori-

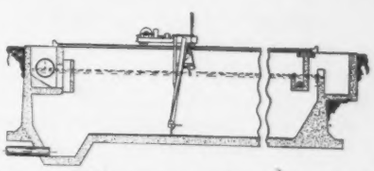


Fig. 33. Eliminates undue agitation in settling zone

zontal position and, the manufacturer states, does not offer any resistance or cause any undue agitation in the settling zone of the tank. (Fig. 33.)

Dust Arrestors

A number of improvements in dust arresting equipment have been announced during the past year. Of greatest interest are improvements directed to extend or eliminate interruption in operation for cleaning or repairs.

The continuous suction air filter announced by the Northern Blower Co. (Rock Products, May 9) employs three units, any one of which may be cut out for repairs or inspection without stoping the others. Cleaning of the filter units is automatic.

Working on an entirely different principle, a wet type dust collector was introduced by Claude Schneible (Rock Products, August 15).

The W. W. Sly Manufacturing Co. filter, which makes an initial cleaning by reducing air velocities, completes its operation by filtration through cloth envelopes (Rock Products, September 12). Removal of the dust collected may be either automatic or by hand-operated valves. The manufacturer states that installations of this new type filter have been made at a cement plant near Birmingham, Ala., at the South Dakota state cement plant, and that a large double continuous unit is now being installed in Texas.

A mechanical dust collector designed for application where the Cottrell process cannot be applied because of combustible mixtures or the small size of installations was announced by the Western Precipitation Co. (Rock Products, June 20).

The Dust Recovery and Conveying Co. announced a self-contained portable dust collector to facilitate the study of dust and fume problems.

The Raymond Brothers Impact Pulverizer Co. introduced a dust collector for use on gypsum kettles. The device operates on the cyclonic principle and means are provided to maintain the kettle "fog" above the dew point.

Dust Recovery, Inc., announced the Vortex cinder catcher (Rock Products, December 19).

Compressors

Several new features and improvements were announced in compressors during 1931. The Curtis Pneumatic Machinery Co. developed a new line of industrial compressors; the chief features are the carbon-free valves, the use of Timken bearings on the crank shaft and the Curtis "Centro-ring" oiling method. The valves are of the light disc type, double heat treated, and made of rust-resisting metal. They have single large non-obstructed ports and are said to be carbon-free as a result of the design of the compressor head. The main bearings, which are Timken roller bearings, are said to be mounted to preserve the rigidity of the shaft and to take care of any thrust loads that may arise during operation. This line, known as the model "C" Timken bearing compressors, consists of seven models, five of the two cylinder type, ranging in size from 4¼x3¾ to 6½x5, with a displacement of 25 cu. ft. to 125 cu. ft. and two of the four cylinder type, a 5½x5¼ and a 6½x5¼ with a displacement of 115 cu. ft. to 262 cu. ft. They are furnished both as stationary simple compressors for belt drive and as complete self contained units. (Fig. 34.)

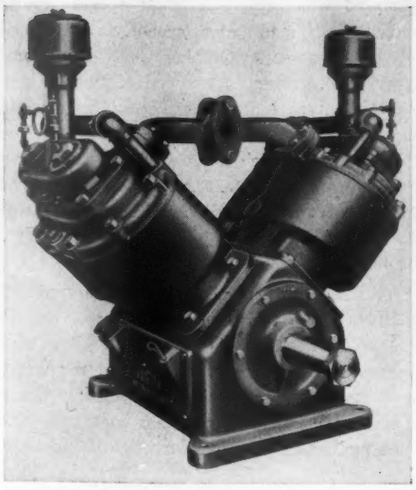


Fig. 34. Roller bearings on crankshaft

The Pennsylvania Pump and Compressor Co. announces improvements in its compressors, which include its air cushion valve. Features claimed for this valve are the air cushioned pocket and the method of holding the seat and guard by a retaining ring which eliminates the use of bolts or screws. Its dual control for air compressors, which was announced previously, is said to have been in more prominence in 1931 than heretofore. Other improvements announced on these compressors are the mercoid control of five step, two stage duplex air compressors and the overhead multiple belt drive for horizontal compressors which is said to effect considerable saving in floor space and provides an efficient and silent drive.

The Chicago Pneumatic Tool Co. announced a portable compressor with capacity of 360 cu. ft. per min. (Rock Products, August 15). It also announced a portable compressor with 6-cylinder engine having a capacity of 120 cu. ft. per min. Features claimed for this compressor include total lack of vibration, full force feed lubrication of compressor and engine, direct drive through quick-detachable flexible coupling and counterweights forged integral with compressor crank-shaft.

The Gardner-Denver Co. announces its V-type 4-cylinder compressor direct connected to synchronous motor having totally enclosed construction. Features claimed for this series are that its oversize three-bearing crankshaft has counterweights forged integral with shaft, positive and automatic oiling system and the cylinders are cast en bloc and completely surrounded by water jacket. All parts requiring adjustment are said to be easily accessible. The manufacturer states this compressor is suitable for maximum continuous service up to 125 lb.

The Sullivan Machinery Co. has announced additions to its line of vertical single acting compressors (Rock Products, November 7).

Lime Equipment

The only announcement of new lime hydrating equipment was made by Arnold and Weigel, Inc., who are now manufacturing a half-ton hydrator for small plants or special installations, equally adaptable for both high calcium and high magnesium limes. The manufacturer states this hydrator is automatically supplied with raw lime, and water and will handle from four to six batches of lime per hour. During hydration the lime is turned over 12 times per min. Dust and water vapor are carried away through a stack either to the open or to a wet dust collector where fine parts are collected. Special provision has been made to eliminate dust when dumping the hydrator. (Fig. 35.)

Arnold and Weigel, Inc., also announced a new coal feeder for lime kilns (Rock Products, April 25). The manufacturer states it can be adapted to any kind of lime kiln with minor changes.

Dryers

Improvements in drying in conjunction with ball mills are announced by the Hardinge Co. One feature of this system is that the oversize being returned from the

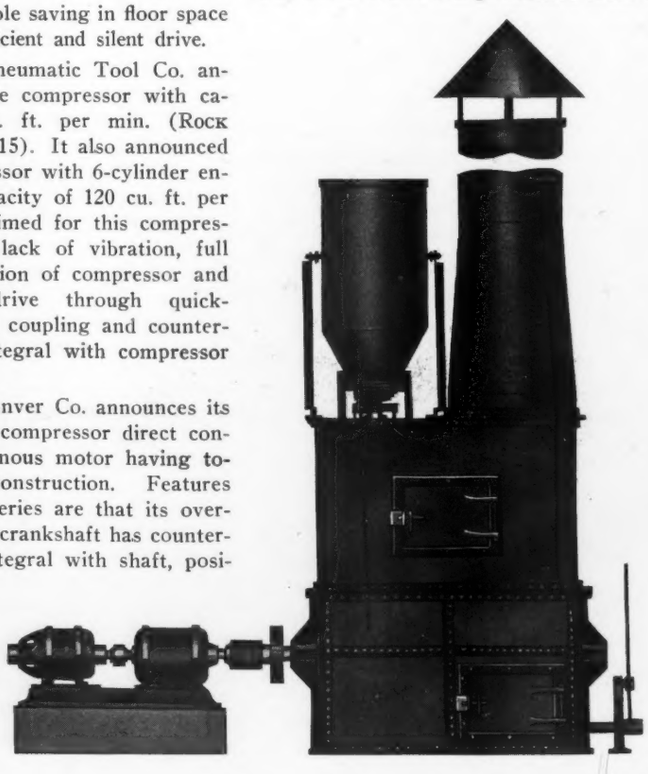


Fig. 35. Hydrates both high calcium and high magnesium limes

classifier to the mill comes in contact with the hot air. This oversize mixes with the incoming feed and thereby warms the unground material more rapidly than with air alone, the manufacturer states. (Fig. 36.)

Another improvement in this system, where unit mills are employed, results from eliminating the passage of material through the fan. It is said this new development makes it possible to place the mill under pressure, so that the fan can be placed on the clean air side of the system to avoid undue wear. Joints are kept clean, the manufacturer states, by having an outer chamber around the joints kept at a pressure below the atmosphere and also below the pressure inside the mill, so that air is drawn into these chambers and sent back to the system.

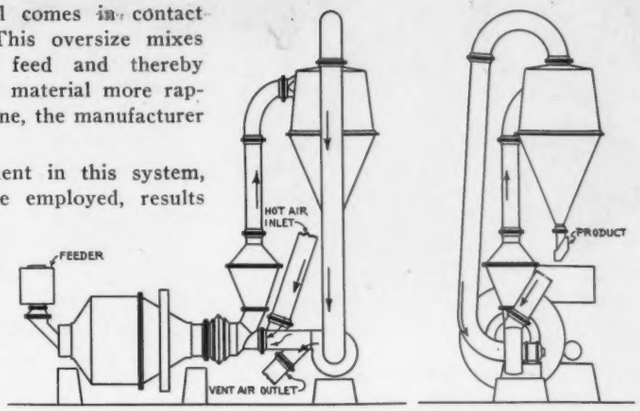


Fig. 36. Oversize mixes with and heats incoming feed

A line of Timken equipped rotary dryers and kilns was announced by the Struthers-Wells Co. (Rock Products, February 28). A new type of dryer was announced by the Louisville Drying Machinery Co. (Rock Products, December 5). This same company also announced a new method of suspension of the central conduits of double-shell dryers (Rock Products, September 26).

Indicating, Recording and Control Instruments

While the principle of operation of the photo-electric tube was discovered about 40 years ago, its practical application to industry is very recent, and in 1931 new and extended applications of this principle to the rock products industry and to other industries where similar problems exist is one of the most important developments in indicating, recording and control instruments.

One very interesting development of this principle which may be found of value to the cement, lime and gypsum industries is the application of photo-electric tubes to the control of furnace temperatures in the steel industry. Until the application of photo-electric tubes the steel treater, with his eyes, controlled the temperature of the furnaces. He compensated for the apparent changes of fire-brightness between night and day and between cloudy and bright days. Now, by means of standardized and calibrated photo tubes an ever watchful attention is maintained to insure exact and unvarying quality.

Many other applications of these tubes and photo-electric cells have been made. Typical is the fact that during the past year the Stephens-Adamson Manufacturing Co. has designed and built two ready-mixed concrete plants in which the concrete proportions were controlled by photo-electric cells or "electric eyes" on Toledo dial scales. One of these plants, built for the Cranford Co., Brooklyn, N. Y., was described in Rock Products, September 26. This principle is being used in many recording instruments, also.

Other equipment announced which employs this principle includes a photo-electric relay, designated CR-7505-G-5, designed for high-speed operation. This device is expected to be of greatest value in those operations where speed would be a limiting factor, were a mechanical type relay used instead of the Thyratron tube. This relay is manufactured by the General Electric Co.

Another General Electric product is a photo-electric device which automatically draws for permanent record the color curve of a sample in the visible spectrum (Rock Products, February 28). This same company announces the use of these tubes in recording instruments incorporating practically any of the General Electric indicating instruments (Rock Products, July 18).

A development to facilitate the examination of minerals and metals has been announced by the General Electric Co. This is accomplished by means of a small, portable cathode-ray tube which makes possible an x-ray spectroscopic analysis.

Improvements in its strip chart recording instruments, type CD, are also announced by General Electric. The chart reroll unit is now separate and spring-driven, releasing the clock of all duty except keeping time.

A new potentiometer pyrometer in indicating, recording, multiple recording and controlling types was developed by the Brown Instrument Co. (Rock Products, July 18). Improvements to the "Micromax" potentiometer pyrometer were announced by the Leeds and Northrup Co. (Rock Products, October 24).

An instrument to afford the boiler room a constant indicator and the engineer's office a written record of the smoke condition of the plant stack was announced by Leeds and Northrup (Rock Products, April 25).

Another instrument which is particularly interesting because of the rapidly increasing use of gas as an industrial fuel is the Brown Instrument Co. recorder for checking the heating effect of fuel gas which is called the "Flame Analyzer" (Rock Products, July 4).

A pressure gage of the dead weight tester type claimed to have unlimited power for the operation of indicators, recorders and control devices are features of the power type pressure device announced by the Bailey Meter Co. This device is in effect a dead weight gage tester combined with a hydraulic torque amplifier and a Selsyn motor system of long distance transmission.

The manufacturer states the Selsyn motor system of transmission which is employed permits of the installation of master pressure indicators or recorders in the control room on the switchboard without fear of leaks from pressure lines.

A solenoid-operated valve for controlling liquids and gases under pressure which can be used for operating steam or air whistles, for remotely controlling the supply of oil or gas to furnaces and for controlling the flow of water in jackets on compressors is announced by the General Electric Co. (Rock Products, August 29).

A time switch which automatically starts and stops motors or turns lights on and off at various intervals was announced by the General Electric Co. (Rock Products, August 1).

A time delay switch which, it is claimed, is unaffected by temperature changes or operating conditions, is announced by the Lincoln Electric Co. The operation of this switch is similar to the hour glass, since its principle is the slow movement of mercury from one chamber to another. This device is mounted in connection with the contactor switch so that when this main switch goes in the delay switch is changed immediately to a vertical position, and vice versa when the main switch is thrown off. It is built for an accurate time delay of 2 to 20 seconds.

A portable testing kit for checking current and voltage in alternating current lines without disconnecting leads or opening the circuit under test was announced by the General Electric Co. (Rock Products, July 4).

A design of benchboard construction which makes possible the use of standard controllers, push-buttons, indicating lamps, etc., was announced by the General Electric Co. (Rock Products, November 7). This benchboard is designed especially for use in connection with conveyor systems and remotely controlled haulage or larry car systems.

Motors

A number of new developments have been announced in motors during 1931.

The Lincoln Electric Co. announced a totally enclosed fan-cooled, induction motor with many new features (Rock Products, January 31).

A new combination multi-speed drive and motor constructed to give four different speeds to the output shaft at constant horsepower with which the speed of the driven apparatus may be changed instantly while the motor is running at full speed and under full load was announced by the Westinghouse Electric and Manufacturing Co. (Rock Products, June 6).

A new motor with separable mechanical and electrical parts was also announced by the Westinghouse Electric and Manufacturing Co. This new type CS is a W-frame, squirrel-cage induction motor, in which the different parts of the motor are entirely separate units. It is said that damaged electrical parts can be replaced without replacing or rewinding the motor.

Following are a few applications of this motor: vertically mounted and horizontally mounted motors; motors without feet vertically mounted or flush mounted against the side of the machine; and open, semi-enclosed and totally enclosed motors. The photograph shows the following parts: standard cast frame (1), standard pre-wound core (2), standard die-cast rotor (3), sealed sleeve bearing shaft (4), standard sealed sleeve bearing brackets (5) and (6), and a new Westinghouse type CS motor (7) equipped with sealed bearings. (Fig. 37.)

The Westinghouse Electric and Manufacturing Co. also produced a 350-hp. hoist motor for a slope inside of mines to move loads from one level to another (Rock Products, February 14).

Another development announced by the Westinghouse Electric and Manufacturing Co. is a totally enclosed, fan-cooled, squirrel-cage motor for use in explosive atmospheres which is said to meet the latest specifications of the National Board of Fire Underwriters for use in class 1, group D, hazardous locations (Rock Products, November 7).

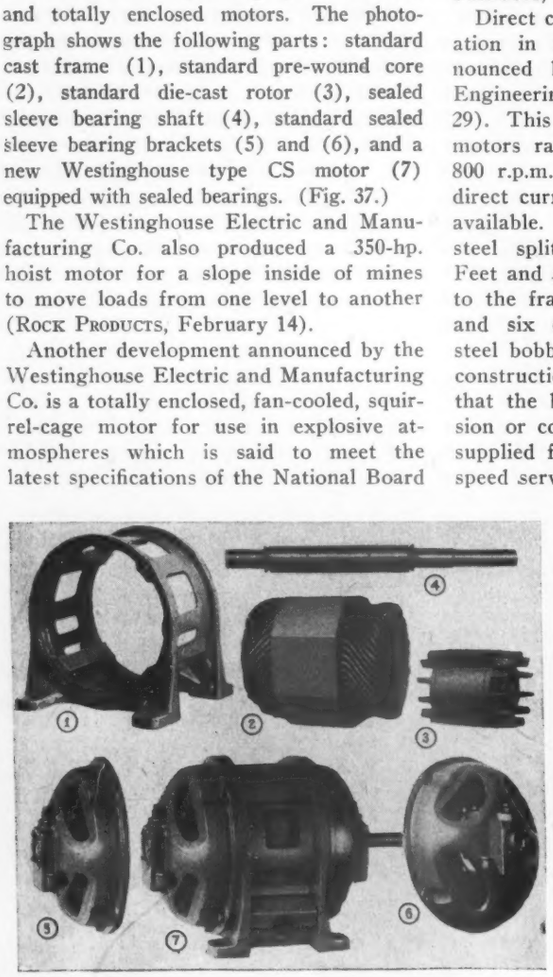


Fig. 37. Damaged parts replaced without rewinding motor

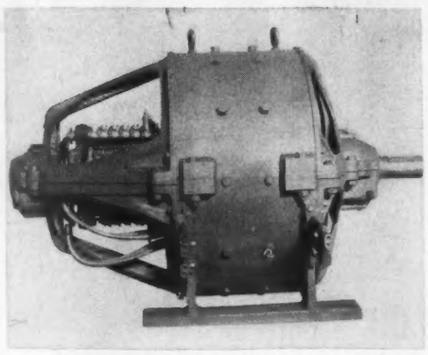


Fig. 38. Uses welded frame construction

The Howell Electric Motors Co. also announced a new motor said to bear the approval of the Underwriters' Laboratory for class 1, group D, hazardous locations (Rock Products, May 23).

The Electric Machinery Manufacturing Co. announced that arc-welded fabricated steel and stator frame construction will be used for all of its medium and slow speed E-M synchronous motors (Rock Products, April 14).

Direct current motors for vertical operation in sizes up to 50 hp. were announced by the Reliance Electric and Engineering Co. (Rock Products, August 29). This company now announces that motors ranging in size from 100 hp. at 800 r.p.m. to 350 hp. at 1200 r.p.m. for direct current in its type T line are now available. In these larger sizes a rolled-steel split frame construction is used. Feet and supporting members are welded to the frame. There are six main poles and six commutating poles where the steel bobbins are used. It is claimed the construction of the commutator is such that the bars will not loosen on expansion or contraction. The motors may be supplied for constant-speed or adjustable speed service with a range of 2 to 1 or 3 to 1. (Fig. 38.)

New devices, or motor accessories, announced include the adoption of a double sealed ball bearing as standard on all "Red Band" motors, manufactured by the Howell Electric Motors Co. (Rock Products, July 4). The Lincoln Electric Co. announced that welded steel motor bases of one-piece construction are available for electric motors (Rock Products, July 4.) A drip cover which can be applied to either its alternating or direct current motors was announced by the Reliance Electric and Engineering Co. (Rock Products, August 1).

A new oiling feature for fractional horsepower condenser start induction run motors is announced by the Howell Electric Motors Co. This new feature consists of two oil wells, one for each bearing, each having a reserve capacity of 2 cu. in. of oil. Each well is connected with the other at the bottom. It is said to be non-spillable no matter what position the motor is in.

Motor Controls

An important development in motor control equipment which makes possible exact agreement of operating speeds of two or more non-synchronous electric motors was announced by the General Electric Co. (Rock Products, March 28). The first application of this system was at the Keystone Portland Cement Co. plant where it was installed to maintain the feed of raw material exactly proportional to the speed of kiln.

Three control devices were announced by the Allen-Bradley Co. Its line of Bulletin 800 push-button control stations is expanded by 4- and 5-button stations. The type N-1060 series of 4-button stations have three running buttons giving three motor speeds and one "stop" button. They are suitable for installations with three speed squirrel-cage type. The addition of a two-way lever switch to the stations converts them into type N-1090 series 4-button stations. The two-lever positions may read Off-On, Inch-Run or Safe-Run. The 5-button stations are for use with 4-speed multi-speed motors giving 4-running speeds and "stop." This company also announces a line of automatic multi-speed across-the-line switches for 2, 3 or 4 speed, non-reversing service in connection with two or three phase, mutispeed motors of consequent-pole-winding or separate-winding type in ratings up to 40 hp., 220 volts and 75 hp., 440-550 volts, 25 to 60 cycles. An optional feature of these switches is a slow-speed-start interlock which compels the operator to follow a definite sequence in starting the motor.

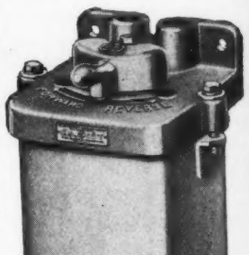


Fig. 39. Reverse spash-proof switch

The third announcement of the Allen-Bradley Co. is of a drum reverse switch of splash-proof construction for use in those places where an open-type of switch is undesirable. Heavy felt gaskets exclude all dust and moisture. Contacts are oil-immersed. (Fig. 39.)

Cutler-Hammer, Inc., has also announced several new types of motor starting and control equipment. A new oil immersed explosion-proof auto transformer type automatic starter for alternating

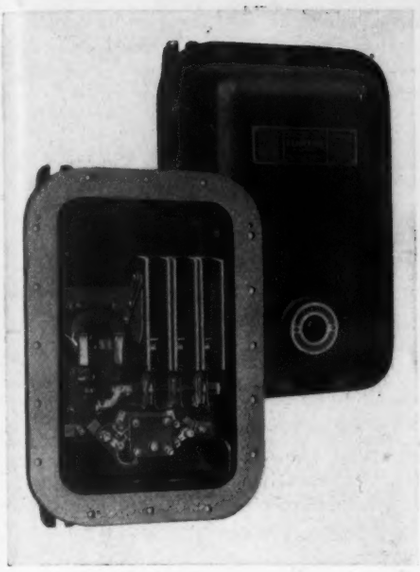


Fig. 40. Heavy case prevents explosion danger

current squirrel-cage motors is designed to comply with the Underwriters' requirements for class 1, group D. It provides a 6-in. head of oil above the contacts and incorporates oil level indicator and outside spout for replenishing the oil without removing the cover. Terminals are located above the level of the oil and will not cause short circuiting. Application for these starters is found in locations where explosive or corrosive gas or dust may be prevalent. An explosion-proof across-the-line type alternating current automatic starter designed in accordance with the specifications of the Underwriters' Laboratory for class 1, group D, hazardous locations was also announced by Cutler-Hammer, Inc. This starter is of the air break type. All contacts are made and broken in the air and there is no oil tank. The cast iron explosion-proof enclosure is designed to prevent any explosion which might occur within it from igniting the surrounding atmosphere. The enclosing case is of the "split" type which when opened is said to allow easy access to all parts of the starter. (Fig. 40.)

A line of enclosed automatic motor starters for two-speed separate type squirrel-cage motors was also announced by Cutler-Hammer, Inc. (Rock Products, February 14). Its entire line of type AAA automatic starters for small alternating current motors to incorporate a newly developed "Twin-Brake" magnetic contactor was announced (Rock Products, April 11).

A new across-the-line type reversing starter for direct and alternating current polyphase motors up to 3 hp. was announced by Cutler-Hammer, Inc. (Rock Products, June 6). It also announced a new float-operated motor starter for small alternating current and direct current motors on drains, sump pumps, open tanks and similar applications (Rock Products, August 29).

The Electric Controller and Manufacturing Co. announced a new and larger type ZO starter as a self-contained unit (Rock Products, September 12). It also announced a 2300-volt magnetic starter for across-the-line starting of squirrel-cage synchronous motors (Rock Products, March 14).

The General Electric Co. announces a new plunger type snap action limit switch designated CR-9441-LS 443 D designed for general industrial applications. The switch has six separate electrical circuits, three normally open and three normally closed. Each contact arm in the switch may be removed by taking out a screw to the terminal studs for connecting the control lines. The switch is said to be of rugged construction and particularly adapted for rough-duty applications. General Electric also announces a new motor starting switch designated CR-1062 C2 which was designed for use with general purpose motors requiring pedestal mounting.

The Rowan Controller Co. has introduced a combination safety switch and magnetic contactor for use with small alternating current motors (Rock Products, August 29).

Ready-Mixed Concrete Equipment

During 1931 a truck concrete mixing unit designed both for mixing or for use as a closed type agitating body for conveying premixed concrete was announced by the Blaw-Knox Co. (Rock Products, April 25).

The Chain Belt Co. announced the addition of a hoist to truck mixers to increase the spouting range of this equipment (Rock Products, November 7). The "Transport" mixer with capacities of one to three cu. yd. was announced by the Concrete Transport Mixer Co. (Rock Products, August 1). The International Harvester Co. announced a truck chassis with Blaw-Knox ready-mixed concrete equipment and equipped with a Heil Hi-Lift hoist. (Fig. 41.)

Two new developments were announced by the Jaeger Machine Co. The first is a rear lift hoist attachment to increase spouting area and the second is a 1-1½ cu. yd. separate engine drive truck mixer (Rock Products, October 24). The National Equipment Corp. announced its Smith truck mixer and agitator (Rock Products, July 4).

A vertical screw elevator for unloading bulk cement from steel container cars was announced by Sprout, Waldron and Co., Inc. An accompanying illustration shows this equipment as it was developed for unloading the "Hercules" car. It consists of two parallel and one horizontal flat screws encased in water-tight cases. These carry the cement to the special vertical screw elevator which carries it to the bin. Advantages claimed for this equipment are lower first cost, less upkeep and freedom from troubles caused by bad weather conditions. For regular cars power shovel unit is used to get the cement from cars to a special hopper

Fig. 41. Bathtub type agitator body

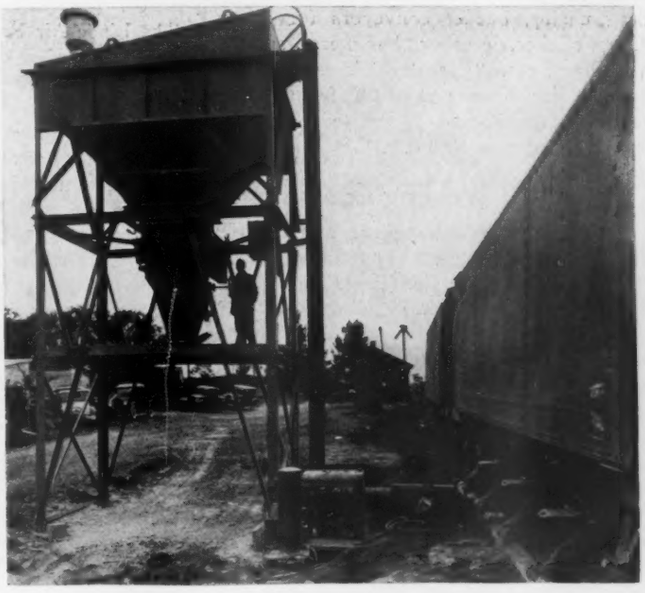


Fig. 42. Screws convey from car to bin

which feeds the vertical elevator. (Fig. 42.)

A hydraulic washer with silent enclosed pump designed for car washing which is adapted to washing out ready-mixed concrete trucks was announced by the Curtis Pneumatic Machinery Co. (Rock Products, February 14).

Alloys

Elsewhere in this issue is a comprehensive article discussing 1931 developments in the alloy field. New applications of these various alloys have been found and increased use in established markets is reported.

During the year the Link-Belt Co. announced that "Promal," a processed malleable iron developed and used by the company in its own chain products would be available to all manufacturers (Rock Products, October 24).

The Fuller-Lehigh Co. has just announced that it has secured exclusive sales rights to "Adamantine," a grade of steel said to have been initially developed by the Chrome Steel Works for use in the reduction and pulverization of rock products and ores. It will also market "Elverite," a chilled iron said to have exceptional hardness and suitable where great strength and machinability of wearing surface are not required.

The Morris Machine Works announces "Flintmetal," a hard iron said to be especially adapted to handling fine abrasives such as slurry, grit and sand, and "Flintalloy," a steel mixture of which the hardness and brittleness can be controlled by heat treatment so as to suit various requirements when handling the larger abrasive solids.

Two other alloys announced are "Pyrasteel" and "Evansteel," manufactured by the Chicago Steel Foundry Co. Applications of these alloys in the rock products industry include kiln ends, heavy duty drag chains, bucket conveyors for handling clinker, crusher hammers, screw conveyors, etc. "Pyrasteel" is said to be suitable for temperatures of from 1000 to 2200 deg. F. and "Evansteel" is for temperatures up to 1000 deg. F.

Cutting and Welding Equipment

Only one new welding set was introduced in 1931. This was announced by the General Electric Co. (Rock Products, August 15). It is manufactured as a stationary set but with slight changes is convertible to a portable unit. It will operate on either alternating or direct current at standard voltages.

A number of new welding rods were announced, three of which were by the American Manganese Steel Co. One of these is a rod for repairing and building of either manganese steel castings or other steels and another for hard surfacing (Rock Products, April 25). It also announced a nickel manganese steel welding rod suitable for use in the repair of manganese steel castings and the reclamation of manganese steel equipment (Rock Products, September 26).

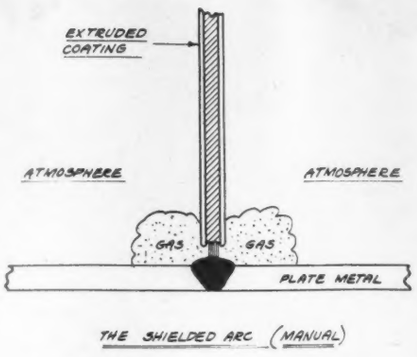


Fig. 43. Coated electrode reduces spattering

General Electric Co. announced a heavily coated electrode said to give deposits having high tensile strength (Rock Products, September 12).

The most recent announcement of welding rods by the Lincoln Electric Co. is of an improved heavy-coated electrode (Fig. 43) for welding within the shielded arc on mild steel, the principle of which is shown in an accompanying illustration. This rod is to replace its predecessor, "Fleetweld."

The Lincoln Electric Co. also announced an electrode utilizing the shielded arc process to build up worn manganese castings (Rock Products, August 1). An electrode was introduced by the Lincoln Electric Co., known as "Hardweld," for building up worn steel wearing surfaces (Rock Products, August 15).

The Armite Laboratories also announced a group of new hard facing products for application on friction surfaces for applying with the electric arc and by the oxy-acetylene method (Rock Products, June 6).

The Linde Air Products Co. announced the addition of a cutting blow-pipe and cutting attachment to its line of "Prest-O-Weld" medium pressure apparatus of the detachable valve body design (Rock Products, August 15); also two additions to its line of "Purox" medium pressure apparatus, a new welding torch said to have a wide welding range and a cutting attachment said to cut metal up to 2 in. in thickness (Rock Products, September 12). It also announced a standardized set of markings on all "Oxweld" welding rods (Rock Products, October 24). A new type of welders' goggles designated as "Oxweld" No. 12 were introduced by the Linde company.

Asphalt Plants

The development of public interest in low cost roads and the increased expenditures on them has directed the attention of sand and gravel and crushed stone producers to the possibilities of the installation of equipment to supply bituminous road materials.

A portable plant of this type which can be set up in sand and gravel plants was announced by the Chausse Oil Burner Co. (Rock Products, September 26).

Another plant, the Cedar Rapids Pre-Mix, has recently been announced by the Iowa Manufacturing Co. This plant consists of two major units, the dryer and the pugmill. The truck mounted drier unit consists of a revolving cylinder into which aggregates are continuously fed. Heat is supplied by two atomizing type fuel oil burners. Power is furnished by a gasoline engine. (Fig. 44.)

An enclosed bucket elevator takes the dried aggregates as they are discharged from the dryer drum and deposits them into a rotating quadrant batcher. Here the aggregates are weighed into 200-lb. batches and discharged into the mixing chamber or pugmill.

The aggregate batcher and the bitumen batcher are synchronized to operate together so that every time the aggregate batcher trips it also trips the bitumen batcher and releases into the pugmill at the same time along with the aggregates a predetermined amount of hot bitumen. The oil batcher is so designed that it can be set to discharge a given amount of bitumen depending on what proportions are desired in the finished mix.

The aggregate and bitumen are thoroughly mixed by a series of screw conveying paddles operating on a central shaft inside the pugmill. After the material is thoroughly mixed it is discharged into a loading hopper for loading.

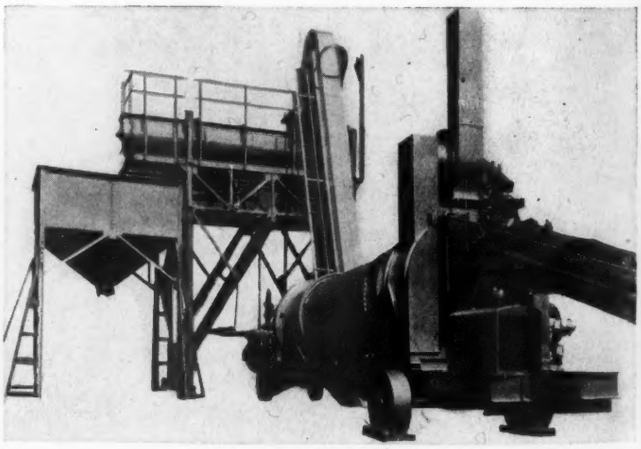


Fig. 44. Complete plant in two units

Cement Products

TRADE MARK REGISTERED WITH U. S. PATENT OFFICE

1931—A Year of Achievement in Concrete Masonry Industry

Soundness of Business Established—A. S. T. M. and Federal Specifications Adopted—Wall Stability Tests Conducted—Value of "Air-Dry" Units Recognized—Concrete Ashlar Construction Developed

By W. D. M. Allan

Manager, Cement Products Bureau, Portland Cement Association

DEFINITE PROOF of the soundness of the concrete masonry industry is recorded in the fact that it got a larger percentage of the available business in 1931 than in any previous year. This achievement was made possible, first, because the industry now has definite standards of quality which regularly are met by a large percentage of manufacturers, and, second, because the industry now has one of the best trained sales organizations in the building field.

Unquestionably, the principal achievement of 1931—and one of the greatest in the history of our industry—was that several hundred manufacturers, despite distressed conditions, liberally contributed funds to help carry on a wall investigation at the University of Illinois. This investigation was made, data were compiled and published, and, as a result, concrete masonry is established as a superior material.

The most important research undertaken by the concrete products industry prior to 1931 was carried out in 1921 and 1922 when the fire tests, with which we all are familiar, were conducted at the Underwriters' Laboratories, Inc., in Chicago. While these early tests did not give all concrete masonry a clean record, they did show many types of units possessed excellent fire-resistant properties. And, which was more important, these tests showed why certain units failed. Then the industry straightway corrected its errors, until today a substantial proportion of all concrete masonry units made in the United States are eligible to the Inspection Service of the Underwriters' Laboratories, Inc.

University of Illinois Tests

Next in importance was the wall stability investigation at the University of Illinois which I have mentioned. This investigation was made possible only because a large number of far-sighted manufacturers contributed funds, some of them in the face of an impending deficit, to pay the bill. The Portland Cement Association also contributed funds and represented the concrete masonry industry at the university while the tests were being made. The report of the tests was made public as a paper, "Tests of the Stability of Concrete Masonry Walls," by F. E. Richart, Research Professor of Engineering Materials, University of Illinois; P. M. Woodworth, Engineer, Portland Cement Association, and R. B. B. Moorman, Special Research Assistant, Theoretical and Applied Mechanics, University of Illinois. Professor Richart presented the paper in Chicago at the June, 1931, meeting of the American Society for Testing Materials.

Professor Richart also will discuss the significance, to manufacturers and users of concrete masonry units, of the data developed from this investigation, in another paper, "The Structural Performance of Concrete Masonry Walls," to be presented at the convention of the American Concrete Institute in Washington, D. C., March 1 to 4, 1932.

Twice Clay-Tile Wall Strength

This wall stability investigation established the fact that, for end construction units, concrete masonry of the same strength as clay tile, except for some few high-priced special designs, will give twice the wall strength. The full value of these tests is just beginning to be appreciated by the industry. In the course of the next two or three years the results of the tests will be of great aid to concrete masonry salesmen in establishing the stability of concrete products. Furthermore, this in-

Berks County Prison, Reading, Penn., an outstanding concrete masonry job which required 246,000 colored and textured units

vestigation may have far-reaching effect on specifications for all types of hollow masonry units.

Another important achievement in 1931 was the tentative standard specification for concrete masonry units adopted by the American Society for Testing Materials. With the help of the Portland Cement Association, the concrete masonry industry had been working for this specification for more than two and one-half years. The wall tests conducted at the University of Illinois played an important part in presenting data necessary to have this specification adopted. The American Society for Testing Materials is an internationally known technical organization, and its adoption of the specification will aid materially in getting uniform requirements covering concrete masonry in building codes.

The American Society for Testing Materials also is working to establish a specification for concrete brick.

New Specifications

Another important achievement culminated in 1931 was the adoption of specifications for concrete masonry and cast stone by the Federal Specifications Board of the U. S. Government. This board also is at work on a specification for concrete brick.

A tentative specification for concrete burial vaults has been prepared and will be presented to the American Concrete Institute at its next convention.

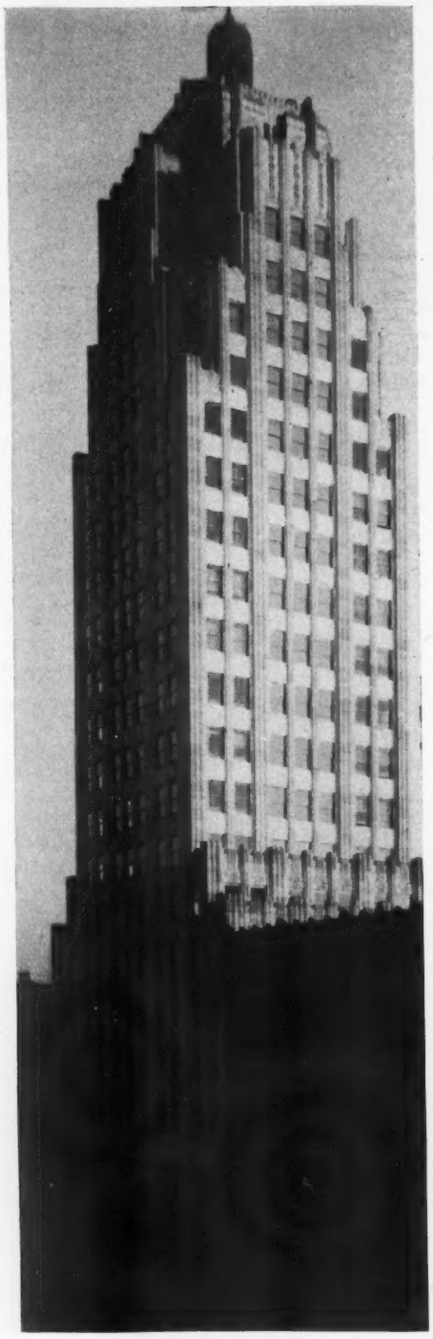
While 1931 has the honor of recording this remarkable technical progress in the concrete products field, it must be remembered that some of the work necessary was started five or six years ago, being watched continuously and advanced from then until now. Only those who have had part in developing specifications with high-grade technical organizations realize the tremendous amount of time and attention that must be given to preparing and adopting such standards.

Concrete Unit Ashlar

The year 1931 also gets the credit for putting concrete ashlar on the map. While considerable experimental work has been carried on for years in different parts of the country, notably in upper New York, southern California and in Detroit, it was not until early in 1931 that the "bugs" were worked out of the construction and it became possible to promote it generally on a sound basis. Manufacturers in Detroit and Los Angeles have supplied information regarding designs of concrete ashlar which are most popular with architects and builders, as well as information on how best to treat the surfaces, whether they are exposed to weather or on the interior of buildings. This information has been made available to all manufacturers through the pages of *Concrete Products* and other magazines.

The Portland Cement Association has widely distributed magazine reprints to architects and contractors showing details of concrete ashlar construction. It also has prepared a new booklet, "Concrete Ashlar," which will be off the press within a few weeks. This publication describes the decorative and acoustic value of concrete ashlar for interior construction.

The principal advantage of concrete ashlar, and this is one of the greatest sales advantages the industry has ever had, is a substantially lower cost for acoustically treated, fire-safe, attractive walls. A concrete ashlar wall decorated with portland cement paint generally can be built at lower cost than an ordinary masonry wall with plain plaster, the latter having practically no decorative or acoustic value.



Lincoln Tower, Ft. Wayne, Ind., backed up with concrete masonry

Many manufacturers in 1931 purchased the small number of additional parts required to equip their machinery for producing the units necessary, in all regular patterns of concrete ashlar, including designs in either the coursed or random manner. The industry also learned that it is not desirable to use units of unusual sizes or to specify patterns of a complicated nature. Therefore, products manufacturers are urging architects and owners to use standard sized units or multiples thereof rather than to adopt unusual sizes and complicated patterns.

Fewer But Better Plants

The tendency toward reduction of the number of concrete products plants, which has been going forward regularly for more than ten years, continued with marked progress in 1931. Hundreds of plants that were poorly organized, inefficient or improperly located have been closed down, many of them never to open again. It was inevitable that this should happen even though the volume of business maintained during 1928 had continued indefinitely. Too large a percentage of marginal plants existed, even at the peak of sales, and those that were grossly over-financed or under-financed and unable to adapt themselves to changing conditions were falling by the wayside even in 1928.

Throughout the present period of reduced volume, the concrete masonry industry is evolving into a much stronger, better trained, more efficient industry, and with the gradual opening up of business in 1932 there will be a reorganized, well-knit industry ready to supply its materials at favorable competitive prices for a much wider market than ever before.

Prices generally have been at cost or below, but hardly any industry can point its finger at any other when the question of prices is being discussed. The concrete masonry industry probably suffered less because of low prices than the majority of industries in the building field. In the beginning, prices were cut with the feeling that "We can stand it for a while, but in a short time we will boost them back again and make up for the present loss." That idea has rapidly disappeared. Practically all leaders in the concrete masonry industry realize that we will not return, for years to come, to the prices of 1927 and 1928, and that it is business suicide to lay plans to cover the present deficit with substantially higher prices with the return of normal business.

Better Technique in Manufacture

One of the most important developments in the manufacturing end of the

Harborview Hospital, Seattle, Wash., in which 175,000 concrete masonry units were used for back-up

Residence of R. L. Megowen, Kenilworth, Ill., built with masonry back-up for stone facing

concrete masonry business that has taken place since the general acceptance of the importance of grading of aggregate in determining the quality of the product, is the need for an extra manufacturing operation to dry the block after they have been wet cured. There are three principal operations in making a masonry unit, whether clay or concrete. These are molding, hardening and drying. In the clay products industry the order is molding, drying, hardening, and in the concrete masonry industry it is molding, hardening, drying.

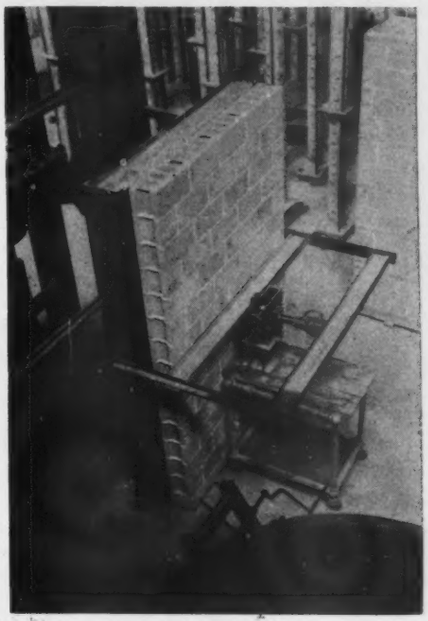
Too little attention has been given to the drying operation as an important factor in producing a thoroughly satisfactory concrete unit for all conditions.

Under the stress of large demand in the period from 1923 to 1928, units were frequently delivered to the job directly from the steam curing rooms in a thoroughly wet condition. These products were not ready for use because one of the important manufacturing operations had not been provided, namely, drying. The drying period after the moist curing period is important in producing a thoroughly satisfactory unit. As long as concrete block were used principally in foundations, where they usually were continuously damp, there was no danger of shrinkage cracks developing, but when the units are used in above-grade construction there is danger of cracks developing in long walls, if the wet block are laid.

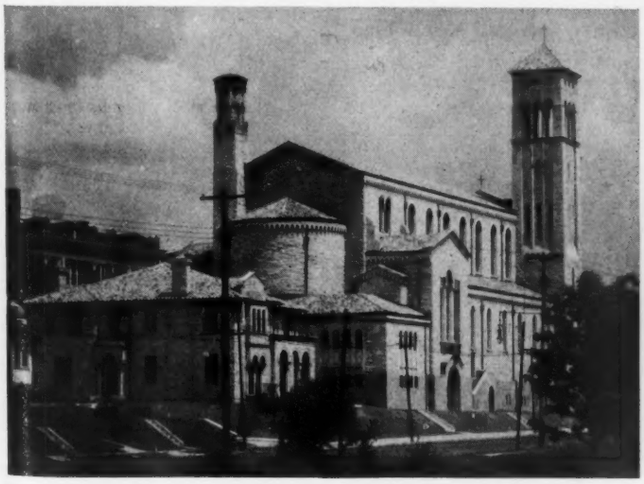
Drying Block Important

The drying operation can be carried on in any one of three general ways.

First, stock pile the block under cover in narrow piles, with cells horizontal so that air can circulate freely through them to dry out the entire pile, or stack them with cells vertical in narrow piles but

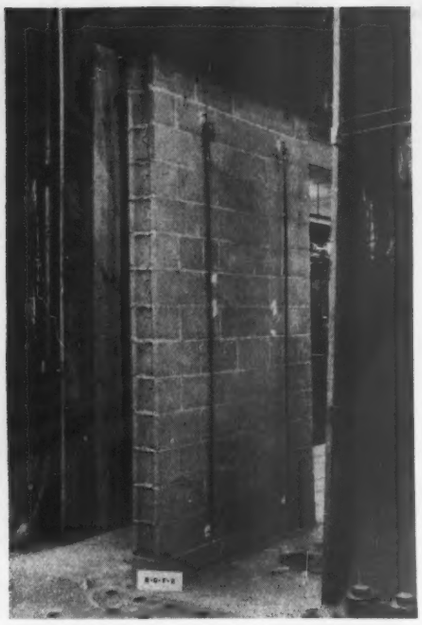


Test of flexural strength of concrete masonry wall at University of Illinois



St. William's Church, Cincinnati, Ohio, in which 90,000 units were used for back-up and partitions

Section of concrete masonry wall ready for compression test



Concrete masonry wall, 6 ft. by 9 ft. 4 in., ready for test of compressive strength

raising the lower course of block up on a 4-in. sill so that the air can circulate freely through the pile.

Second, provide sufficient heating and ventilating equipment in the steam curing rooms to dry out the block after they have been moist cured to develop the strength and density required by the specification.

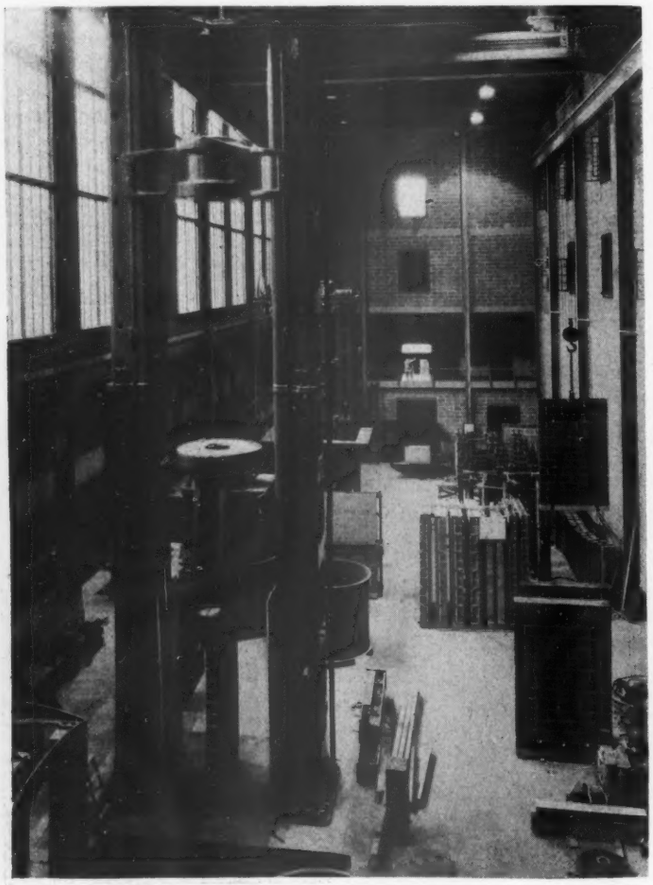
Third, and what many think the most practical and the ultimate method to be used, cure the units in tight cylinders with steam at pressures from 80 to 125 lb. This requires equipment similar to that used in sand-lime brick making.

Steam Curing Desirable

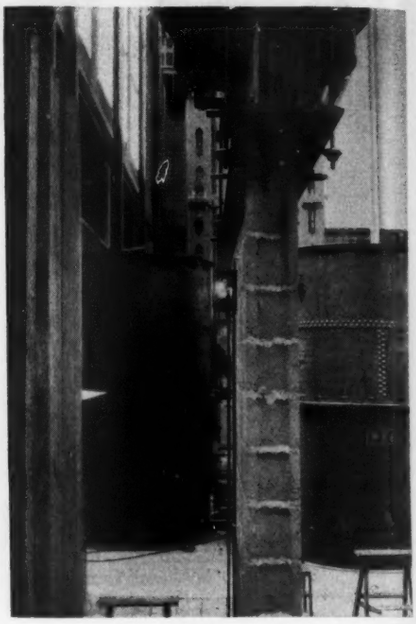
The equipment required to high-pressure-steam-cure 4000 block per day will cost in the neighborhood of $10,000. This may appear to be a large outlay for many manufacturers at present. However, with the revival of business and with the aid of test data which are being developed now in several laboratories, it seems only likely that leading manufacturers seriously will consider the advantages of high pressure steam curing. In this way block made one day are placed in the steam cylinders that night and are removed the next morning, rapidly coming to an air-dry condition, and then are ready for use on the job. High pressure steam curing should not be confused with "drying out" block at high temperatures.

If the high pressure steam equipment is not properly installed there is a danger of drying out the units, thus making them useless. High pressure steam curing conducted under proper conditions can be thought of as forcing into a period of 8 or 12 hours the curing that would ordinarily be obtained in 28 days or more. Manufacturers realize that there is quite a difference between block that are properly high-pressure-steam-cured and those that are allowed to stand in the yard in the open for a long period of time. Wet block a year old are little better than wet block seven days old.

It is principally a question of reducing the moisture content of the block. Several manufacturers realize that building codes and standard specifications soon will provide moisture limitation requirements and, rather than wait until these specifications are actually in force, are making plans to change their manufacturing methods and plant equipment so that "air-dry" units can be delivered on the job.



Testing materials laboratory, University of Illinois, where concrete masonry wall investigation was made



Concrete masonry wall being tested under eccentric loading

Fire Resistance

Research has been carried on during the past year by the Portland Cement Association and by aggregate manufacturers to develop concrete masonry units having a 2-hr. fire retardant classification in conformity with the recent schedules prepared by the Underwriters' Laboratories, Inc. It is intended that such units be used in place of 3-hr. units where building codes or less hazardous construction will permit. Units of the 2-hr. classification, being lighter in weight and lower in cost, should increase market possibilities.

In conclusion, 1931 was a year of outstanding achievement, as summarized below:

(1) A comprehensive series of wall tests on the stability of concrete masonry.

(2) Adoption of A. S. T. M. tentative standard specifications for concrete masonry.

(3) Adoption of federal specification for concrete masonry.

(4) Adoption of federal specification for cast stone.

(5) Progress on A. S. T. M. specification for concrete brick.

(6) Progress on federal specification for concrete brick.

(7) Development of A. C. I. tentative specification for concrete burial vaults.

(8) Development and general acceptance of concrete ashlar for exterior and interior walls.

(9) Recognition of the importance of shipping units in an air-dry condition.

(10) Progress toward developing 2-hr. fire retardant classification for concrete masonry units.

Ready-Mixed Concrete Branch of Rock Products Industry Grows

Number of Plants Increasing Rapidly; Character, Appearance and Equipment of Plants Illustrate Technical Progress

THE CONTINUED rapid growth during 1931 of the ready-mixed concrete industry as regards new plant construction was one of the outstanding developments in the rock products industry. As a result, the total yardage of ready-mixed concrete poured during 1931 will probably greatly exceed the yardage poured during 1930. The gains from new plants in new locations thus offset the loss in production to numerous individual producers.

There was a decided tendency for those already producers of ready-mixed concrete to add new producing units at strategic points in their territories. This territory might be confined to one large city where a new plant would be constructed to more economically serve some part of that city, or the territory might include an entire state or more. This expansion is a result of the necessity of having a sufficient volume of business to keep a minimum number of trucks busy and at the same time to have a sufficient number of trucks available to handle peak demands. By locating several plants within reasonable distances of each other, trucks from one plant can be shifted from plant to plant as needed. For instance, in Canada one company has plants at Niagara Falls, Toronto and Ottawa, all in Ontario, and other plants at Montreal, Que. The distance between these plants is considerable, but not sufficient to preclude the possibility of interchange of haulage equipment. A second new company in Canada likewise has plants at Toronto and Montreal. In the States, in Pennsylvania for instance, at Reading, York, Lancaster, and at Baltimore, Md., one parent company operates as many plants. New York, Cleveland, Detroit, St. Louis, or almost any large city, could also illustrate a single company operating territorial plants.

Technical Developments

The application of modern engineering principles to the refinements of production methods was a feature of the year's developments; and in most of the new plants built the nature of the equipment used was such as to give greater accuracy in weighing both the fine and coarse aggregate and the weighing of cement. Various claims as to the percentage of accuracy obtained by different equipment users all indicated a very low percentage of variation in weighing; in fact, the refinements in this respect take the industry out of the rule-of-thumb class entirely and put it into one in which scientific accuracy and control of product are outstanding. Naturally, accuracy in maintenance of the water-cement ratio also received almost as much attention as in weighing.

As an outstanding example of the scientific trend in production methods we find the application of the photoelectric cell, nicknamed the "electric eye." In our April 11 issue we published an article dealing with the principles involved in the use of the electric eye for the automatic control of batch weighing, and in our September 26 issue a plant was described in which the principles involved were applied.

In this, the ready-mixed concrete industry, the application of the photoelectric cell to its production problems is perhaps the first of many possible applications in the rock products industry, and no doubt is the forerunner of its use in solving other automatic control problems.

Ready-mixed concrete until this year was used for construction work of various kinds, but in the paving field was confined mostly to municipal work. During the year the Ontario Ready-Mix Concrete, Ltd., of Toronto, Ont., using Transit mixer trucks, widened its activities by constructing a concrete highway in the rural sections of interior Ontario. The truck mixers replaced the conventional paving equipment very satisfactorily. The details of this interesting departure were described in the October 10 issue. The trucks were backed in on the sub-grade, which was not protected from rutting. But the trucks used were six-wheel trucks with all pneumatic tires. State highway specifications in the United States almost universally prohibit the trucks from coming nearer than 20 ft. of the end of the unfinished pavement. This has prevented the use of ready-mixed concrete on such work until a device can be perfected for handling the concrete from the truck to the pavement.

An incomplete tabulation of plants in the United States shows some interesting data and tells the story of the growth of the industry. There are, we believe, 15 states which still do not have ready-mixed concrete plants within their borders. These states are Arizona, Colorado, Idaho, Maine, Mississippi, Montana, New Hampshire, New Mexico, Nevada, North Dakota, South Carolina, South Dakota, Utah, Vermont and Wyoming.

In the other states there are at least

An attractive ready-mixed concrete plant which is a marketing asset

265 ready-mixed or central-mix plants operated by 170 companies. Of this total there are at least 92 plants operated by 47 sand and gravel producers. There are at least seven plants operated by seven crushed stone companies and at least 35 plants operated by some 10 companies which produce both crushed stone and sand and gravel. Thus of the total 265 ready-mixed plants in the United States, a trifle over half are operated by the aggregate producers. Many of the remaining ready-mixed concrete plants are operated under company names that conceal their ownership, but there is no question but that a large percentage of the stock in these companies is owned by members of the aggregate producing industry. So interwoven is the relationship between the aggregate producer and the producer of ready-mixed concrete that, during the year, the executives of the National Ready Mixed Concrete Association made arrangements with the National Sand and Gravel Association whereby the executive personnel of the latter organization has conducted the activities of the National Ready Mixed Concrete Association.

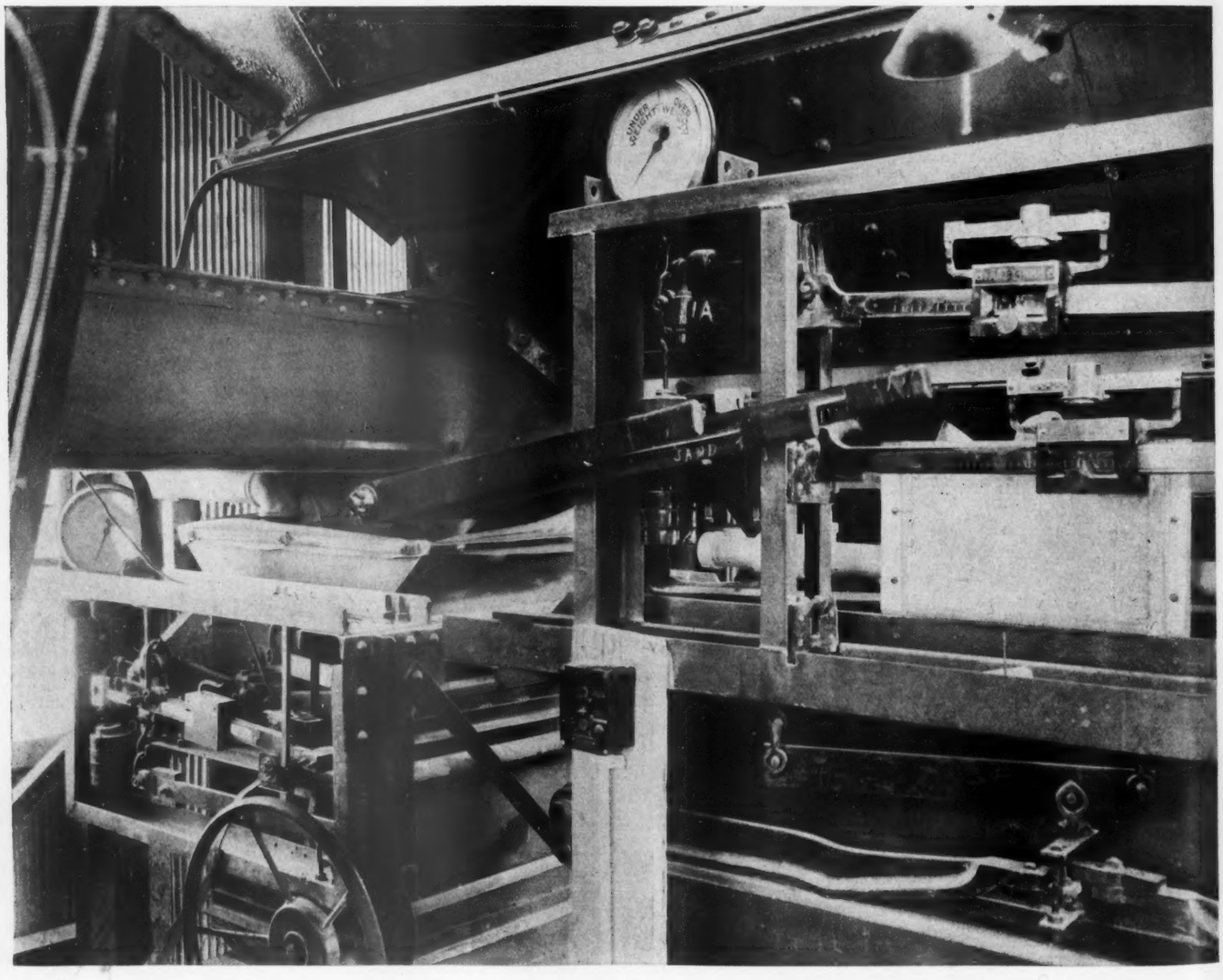
Following is a tabulation showing the geographical distribution of ready-mixed plants in the United States:

	Companies	Number of plants
Alabama	7	7
Arkansas	1	1
California	10	32
Connecticut	5	10
Florida	5	7
Georgia	2	2
Illinois	8	10
Indiana	4	4
Iowa	6	6
Kansas	1	1
Kentucky	2	2
Louisiana	1	1
Maryland	2	2
Massachusetts	4	8
Michigan	4	6
Minnesota	3	4
Missouri	5	11
Nebraska	3	3
New Jersey	8	11
New York	13	19
North Carolina	1	1
Ohio	14	26
Oklahoma	6	9
Oregon	1	1
Pennsylvania	21	33
Rhode Island	1	1
Tennessee	6	12
Texas	8	10
Virginia	2	3
Washington	10	15
West Virginia	3	3
Wisconsin	3	4
	170	265

To our knowledge, the number of trucks owned and operated by ready-mixed or central-mix plants ranges from two as a minimum to 103 as a maximum. Accurate information as to the average number of trucks per plant makes our estimate seven.

New Plant Features

In the newer plants the use of inclined belt conveyors for delivery of the aggregate to bins over scales appears to be the favorite method, these conveyors being fed by clamshell bucket cranes, trucks or standard-gage track hoppers. Installation



Scales at the Mill Basin plant of the Ryan Ready Mixed Concrete Corp., Brooklyn, N. Y., equipped with photo-electric cell for more accurate weighing

of heating plants for winter operations in most of the newer plants and in plants built in previous years was a feature of this season's activities.

Owing to proved inaccuracies, the use of volumetric devices for batching cement and aggregate lost ground, and the use of bulk cement in conjunction with bucket elevators or the Fuller-Kinyon pumping system gained ground, apparently. In one plant built this year, that of Warner Co., at Morrisville, Penn., the aggregate is given a final rinsing and screening before the material falls to the bins over the weighing hoppers. The aggregate used is a scrubbed, washed and screened product from the company's sand and gravel plants near by, so the user of ready-mixed concrete is assured of the best and cleanest material obtainable. This is an advanced step and indicates what the modern plants of the future may all include in the endeavor to provide the highest possible quality of concrete.

Catering to the wishes of the buyer of ready-mixed concrete is indicated from the number of producers who stock several brands of cement both bulk and bagged. Many of the plants stock three brands of cement and some stock as many as six brands of bulk cement.

During the year several new types of trucks were brought out. The tendency seems to be toward the use of a separate gasoline motor for rotating the mixer. Means of raising the mixer body to a height sufficient to chute the concrete across considerable horizontal distances was also a feature of some of the newer truck mixer bodies.

The use of aluminum body trucks has already been tried and proved feasible and economical by one crushed-stone producer. It is quite likely we shall soon see them tried out for ready-mixed concrete, especially if aluminum manufacturers are able to develop an alloy with more resistance to abrasion.

Several cities and localities have several companies competing with each other, so that merchandising methods, advertising, etc., are being studied and developed by producers much more effectively than aggregate producers have ever done before. Naturally, one form of advertising of a product the principal characteristic of which is *quality* is in the design and construction of the ready-mix plant itself. It has become a tendency for one to judge a product somewhat by the general appearance of the plant that produces it. If the plant is a makeshift affair there is apt to be a feeling that its products will be of similar character.

Some of the older and some of the later built ready-mixed concrete plants are unsightly. An outstanding exception is the new plant of Warner Co., at Morrisville, Penn. This plant, built on the main line of the Pennsylvania railroad between New York City and Philadelphia, has taken advantage of the advertising value of this location by building a plant that is architecturally a beautiful structure (at least to an editor's eye). On seeing this tall aluminum-painted steel structure, one cannot but be impressed with the fact that it produces a manufactured product, and hereafter he will have a more respectful impression of this industry.

As to the future, we look for a continued expansion of the ready-mixed concrete industry in 1932, particularly as a part of present sand, gravel and crushed stone industry, and undoubtedly present ready-mixed concrete producers will expand their operations to new fields.

Technical Activities of the National Ready Mixed Concrete Association

By Stanton Walker
Director of Engineering

THE PRODUCTION AND MARKETING of ready-mixed concrete has developed into a comparatively large industry within only a few years. While central mixing plants, designed to serve one large job only, were used more than 15 years ago, the practice of manufacturing concrete for the open market is not more than about six or seven years old. A few years ago there were in the neighborhood of 25 plants engaged in the production and marketing of concrete delivered ready for use; today there are well over 200. The rapid growth of this new industry has resulted in the development of many problems which can be solved satisfactorily only by joint action.

To fulfill this need, the National Ready Mixed Concrete Association was organized in July, 1930. Since its organization it has held one convention, and early in 1931 it arranged for a management to handle its affairs. Through the cooperation of the National Sand and Gravel Association the part time services of the executive personnel of that organization were obtained. This arrangement permits the new association to start its operations under the direction of men with long experience in association work, and places at its disposal a well-equipped office and research laboratory. The affairs of the National Ready Mixed Concrete Association are, however, administered entirely independently of those of the National Sand and Gravel Association.

Due to the youth of the organization and the comparatively short time that it has had facilities for carrying out work, not a great deal can be written concerning its accomplished technical activities. Much can be said, however, of the problems on which information is needed. A large share of the time of the first year necessarily has been spent in organizing activities on a business-like basis. In addition to the routine of the business affairs, this has involved compilation of lists of producers, the building up and classification of mailing lists, preparation of literature, contacts with committees interested in the industry, and a study of the problems of the industry to determine what work will be of most value to it. This review touches briefly on the more important activities and plans which may be considered as within the scope of the engineering division; it does not attempt to describe the important work which is being carried on by the association under the direction of the executive secretary.

Purchase Specification for Ready-Mixed Concrete

Early in its organization the association realized that the preparation of a comprehensive and accurate purchase specification for ready-mixed concrete represented a most important requirement of the industry. It was felt that such a specification, to be most effective, should be formulated by a group entirely independent of the industry but by one thoroughly familiar with its problems. President J. E. Burke addressed a request to Committee C-9 on Concrete and Concrete Aggregates of the American Society for Testing Materials, asking its cooperation in a study of that important problem. As a result of this request a special subcommittee was formed for the primary object of preparing a specification covering the proportioning, mixing, delivery, inspection and acceptance of ready-mixed concrete. Its work is under the chairmanship of R. B. Young, consulting engineer, of Toronto, Canada, and Canadian vice-president of the National Ready Mixed Concrete Association. It includes in its membership those interested in the production and use of ready-mixed concrete and in the manufacture of ready-mixed concrete equipment. The work of this sub-

committee is expected to represent a most important factor in the development of the industry. The association is cooperating in the work principally by the collection of data from its membership which will be of assistance in outlining specification requirements. An equitable purchase specification must take into account the accuracy with which the various operations can be controlled, and the degree of uniformity of various characteristics which may be expected; such information can be developed only from studies of existing operations.

The association is also represented on and cooperating with committees of the American Concrete Institute and the American Road Builders' Association interested in ready-mixed concrete. It has been instrumental in arranging for conferences of representatives of the committees of the three organizations (the A.S.T.M., the A.C.I. and the A.R.B.A.) for the purpose of correlating their work and avoiding duplication of effort.

Publications

The preparation and distribution of literature giving authoritative information on products of the industry should be considered as one of the most important functions of any trade association. To a new association this is particularly important, not only because of the value of the information, but also as tangible evidence of activity helpful in maintaining the interest of the present membership and in securing additional members. The program of the first convention, held last January, furnished a nucleus for a series of bulletins; certain of the papers presented there have been reprinted and distributed to all members of the industry, whether members of the Association or not, and to certain important user groups. Several of the members of the Association have been most helpful in contributing data of special investigations which they have conducted. Reports on many of these investigations have been distributed to the membership and others are in the process of preparation. The forthcoming convention will provide a number of valuable papers for further publications. Table 1 gives a list of publications and mimeographed reports which have been distributed during the year.

An important adjunct to the publications distributed by the Association is the comprehensive bibliography of literature which has been prepared. It lists articles from 1911 to date, including more than 300 references.

Problems for Study

The ready-mixed concrete industry offers the opportunity to produce concrete under control closely approximating that which can be had in the laboratory. In order to take advantage of this high degree of accuracy, it is logical that the product be marketed on the basis of guaranteed qualities. To sell on this basis, the ready-mixed concrete producer must be thoroughly conversant with the fundamental principles of concrete proportioning and must have complete knowledge concerning the factors of his operations which affect the quality and economy of his product. Unusual opportunities for carrying out the necessary research to develop information on the various factors at a minimum of expense are offered, since each plant is, potentially, a research laboratory. The executive committee of the Association feels that the most important activity of the engineering division should be to assist in the development and correlation of information on the various operating problems affecting the quality and economy of production. Some of the more obvious problems along these lines are outlined in what follows.

Uniformity of Strength

The marketing of ready-mixed concrete on the basis of a guaranteed strength is a rapidly growing practice. This basis, or a similar one, represents the only method for taking into account the special facilities and specialized knowledge of the experienced ready-mixed concrete operator. A most important consideration in arriving at a basis on which the strength is to be guaranteed is that of the uniformity of the test results. Variations in strength tests are obtained not only on account of actual differences in strength but because of other factors, such as sampling, methods of handling the specimens, etc. As a preliminary step in the study of this problem the Association has requested members of the industry to submit to it results of routine tests of their product together with complete information concerning the proportions, methods of testing, etc. A considerable amount of data has been collected and a great deal more has been promised. The tests are being studied and the results, unidentified as to source, also have been made available to the committee of the American Society for Testing Materials charged with the preparation of a specification for ready-mixed concrete.

Design of Proportions

Accurate methods for the design of proportions are essential tools of the ready-mixed concrete producer. If he does not know how to use them he cannot expect consistently to produce specified strengths with the maximum of economy. In general, the producer does not need to depend on theory, since the continuous nature of his operations makes it possible for him to base his estimates on past experience. Much of the work being carried out in the laboratory, through the cooperation of the National Sand and Gravel Association, is designed to furnish valuable information on this important question. It is planned also to carry out studies at various plants to compare estimated strengths with those actually obtained.

Methods of Sampling

The method used in securing samples of concrete for test is of foremost importance. Variable strength tests are obtained on account of poor sampling methods more often than because of actual variations in quality. Considerable work has already been done by members of the Association and by other organizations which will furnish information on this question. These data are being collected and studied. Other tests should be made and it is desirable to give consideration to the development of a standard method of sampling.

Length of Haul

From the inception of the ready-mixed concrete industry, close attention has been paid to the effect of the length of haul on the quality of the concrete mixed at a central plant. Several groups of tests have been made and they are unanimous in indicating that concrete can be hauled for relatively long periods of time without deterioration; a large share of the tests indicate that actual improvement in strength results. A number of member companies have investigated this problem and data relating to it have been given in reports distributed by the Association. (See Table 1.)

Time of Mixing

The time of mixing of concrete has an important influence on its quality. Common practice based on studies of the usual stationary mixers should not be applied, without qualifications, to ready-mixed concrete operations. The combination of mixing at the plant and agitation during hauling and the mixing in transit in a truck mixer bring new features to the problem. Data on this important question are being collected by several different member companies. In most cases they are being released to the Association for study and correlation. There seems to be no adequate reason why concrete, agitated en route to the job, should be retained in the mixer the usual period of time. In the case of the truck mixer a similar loss in time often occurs on account of the requirement of some organizations that the mixing not be started until the job is reached.

Estimating Quantities

The estimation of quantities of materials for concrete assumes especial importance in ready-mixed concrete operations. Definite volumes of concrete are required and definite quantities of cement per unit of volume of concrete are specified. One of the publications of the Association deals with this question. Further studies are being conducted to compare estimated yields with those actually obtained, and particularly to take into account the shrinkage of the concrete from the time of placing until it is hardened.

The importance of this problem is indicated by the requests for assistance in determining quantities of materials to meet various requirements.

Studies of Equipment

The question most frequently asked is, "What type of equipment is the best?" This

represents a question which, at the present time, the Association does not feel inclined to give attention. Many different manufacturers are furnishing excellent equipment. If they are not all equally good, no comparisons can be made, because continuous improvements are being developed and a comparison today may not be accurate tomorrow. It can be said emphatically, however, that the standard equipment available today, properly handled, will produce concrete meeting the most rigid requirements. The selection of equipment, therefore, is dictated by the nature of the market and other local conditions and by the economy in operations.

There are many studies of equipment which should be and are being conducted. These involve design of drum, rate of rotation, control devices, and many other problems. The general use of ready-mixed concrete has brought about the need for special equipment. Much of this has been developed and more is in the process of development. Special consideration is being given at this time to methods for the distribution of concrete from the truck, particularly in highway construction. For the time being at least, this work is considered as within the province of the equipment manufacturer. The Association will be very glad to cooperate in such work, however, by assisting in outlining tests and interpreting the results.

Miscellaneous Problems

In addition to the typical problems outlined above, numerous others suggest themselves. As an indication of the wide scope of the work to which consideration should be given, the following may be mentioned: Effect of long mixing on grinding of aggregates; effect of admixtures; effect of using different brands of cements; effects of the various factors in ready-mixed concrete operations on durability, volume changes, and workability of concrete; effect of heat resulting from mixing; segregation of concrete; and many others.

Concluding Remarks

This discussion has touched very briefly on certain of the activities of the National Ready Mixed Concrete Association and on several problems of immediate and particular interest to the industry. It should be emphasized, however, that the problems of ready-mixed concrete are no different, in their fundamental aspects, from those of the concrete industry as a whole. All of the large volume of research which has been carried out on concrete is applicable to this new branch of that industry. All of the many problems yet confronting concrete are of special interest to the ready-mixed concrete producer.

The responsibility of the concrete and allied industries in developing information which will insure *all* concrete living up to the high standards set by most concrete is a heavy one. The ready-mixed branch of the industry must accept its fair share of that burden. And certainly, it is only the ready-mixed concrete industry that can be looked to to give any attention to the special problems which it has developed.

Industry after industry has proven beyond argument that its general problems can be solved only through cooperative action. The National Ready Mixed Concrete Association represents a beginning of the necessary cooperation in this industry, but it has not developed to an extent where it can be said to have assumed even an approximately fair share of its responsibilities. The organization is being supported at the present time by a lamentably small number of the more progressive members of the industry. More support must be had if the Association is to measure up to its responsibilities and it is hard to see why every producer who has cast his lot with the industry should not put his shoulder to the wheel.

A major strength, which is at the same time a weakness, of Association work is the fact that the non-member receives benefit from Association activities in almost as great measure as the member. Under such conditions it cannot be expected that adequate support to insure maximum efficiency of effort can be given by the progressive few. It can be said that this industry is new and that sufficient time has not elapsed to organize it completely. There is, of course, an element of truth in this, but it should be emphasized that no permanent organization is formed except through the self-conceived realization of individuals in the industry of the advantages of cooperative action.

Ready-mixed concrete will become, if it has not already done so, the most important branch of the concrete industry. The application of sound business principles and the solution of common problems by group action will insure a steady growth along logical lines.

TABLE 1. PUBLICATIONS AND REPORTS

In addition to the literature listed below, a number of reports and articles have been copied from current periodicals and distributed.

PRINTED PAMPHLETS

1. Estimating Quantities for Concrete, by Stanton Walker.
2. Pre-Mix Concrete from the Viewpoint of the User, by Henry D. Johnson, designing engineer, Bureau of Bridges and Structures, Pittsburgh, Penn.
3. The Proportioning of Concrete for Strength, Durability, and Impermeability, by A. T. Goldbeck, director, Bureau of Engineering, National Crushed Stone Association, Washington, D. C.
4. Tentative Specifications for Ready-Mixed Concrete; Report of American Concrete Institute Committee 504, Miles N. Clair, author-chairman.

MIMEOGRAPHED PAPERS

1. Central-Mix Concrete in Philadelphia, by H. J. Whitten, Warner Co., Philadelphia, Penn.
2. Strength Specifications for Ready-Mixed Concrete, by J. L. Shiely, J. L. Shiely Co., Inc., St. Paul, Minn. (General discussion of problem.)
3. Effect of Haul on Strength of Concrete. (Describes results of few tests carried out by J. L. Shiely Co., Inc., St. Paul, Minn.)
4. Effect of Period of Agitating Ready-Mixed Concrete. (Describes results of tests carried out by Thompson and Lichtner Co., Inc., Boston, Mass., for the Boston Concrete Corp.
5. Bibliography from Current Periodicals on Ready-Mixed Concrete, prepared by the Engineering Division, National Ready Mixed Concrete Association.

Silica Products Co. Plant Damaged by Fire

LEW HANSEN, manager of the Silica Products Co. plant at Clayspur, Wyo., has estimated the loss due to fire at the plant in the neighborhood of $50,000.

Origin of the fire is a mystery, although it is believed by Mr. Hansen that the blaze started in the drying room and spread into the pulverizing room. The warehouse together with 2650 tons of bentonite were damaged. A locomotive and one box car on the track adjoining the factory also were destroyed. Two Diesel engines in the fireproof engine room were undamaged.

The plant was equipped with special machinery required for the production of bentonite and aguajel. Bentonite is used largely in the manufacture of cosmetics and aguajel is used in some portland cements and also in cosmetics. Large quantities of the two products are shipped each week from the Clayspur plant to eastern markets.

It is believed the company will take immediate steps to put the plant in running order.—*Sheridan* (Wyo.) *Press.*

Addendum

A NEWS ITEM in Rock Products, December 19, taken from the *Oneida* (N.Y.) *Dispatch*, reported the city of Oneida was considering the operation of a quarry. The article referred to a quarry owned by the city of Utica, N. Y.

We are now advised that the city of Utica has not purchased a quarry, but near the city has obtained permission to get out stone from a small wayside operation, primarily to provide employment. The stone is reported as soft and the quarry as not suitable for a commercial proposition. The stone taken out will be used in various parts of the city as rip rap along small streams. It is understood that Eastern Rock Products, Inc., of Utica, offered to provide stone at cost by using the unemployed supplied by the city. However, the city officials considered it possible to provide for more employment by taking stone from the local quarry.

Eastern Rock Products, Inc., has a commercial quarry near Oneida and can supply stone for all requirements in the vicinity of Oneida at prices lower than the city can produce employing its own men and equipment, an official of the company states.

Traffic and Transportation

Proposed Changes in Rates

THE following are the latest proposed changes in freight rates up to the week of December 26.

NEW ENGLAND FREIGHT ASSOCIATION DOCKET

23985. To cancel rates on **trap rock or crushed stone**, from Brannen or Trap Rock Siding, Me., to Grand Falls, N. B., as published in B. & Ar. R. R. I. C. C. No. 2241. Reason—Cancel obsolete rates.

24063. To cancel specific commodity rates on **stone, broken or crushed**, in bulk, in gondola or other open top cars (See Note 2), from Thomaston, Conn., to various N. H. R. R. stations as named in N. H. R. R., I. C. C. F-2795. Reason—Cancel obsolete rates.

24073. **Slag, granulated** (See Note 2), from Laurel Hill and Nichols Siding, N. Y., to Providence, R. I. Present, 22c; proposed, 19c. Reason—To provide a rate to Providence, R. I., same as in effect to Boston, Mass.

24079. **Sand, blasting, core, fire or sea** (See Note 3), from Provincetown, Mass., and Rocky Hill, Conn., to Montreal and Lachine, Que. Present, 33½c; proposed, 21½c. Reason—To establish rate comparable with rate in effect to Ottawa, Ont.

TRUNK LINE ASSOCIATION DOCKET

28212. **Gravel and sand**, N. O. I. B. N. in O. C., except blast, engine, foundry, glass, molding, quartz, silex and silica, carloads (See Note 2), from Portland, Penn., to East Stroudsburg or Stroudsburg, Penn., 50c per net ton. Present rate, 70c. (See Note 4.)

28214. **Stone, crushed**, carloads (See Note 2), from Suffern, N. Y., to Passaic Junction, Rochelle Park, Maywood, Lodi, Hackensack and Bogota, N. J., 80c per net ton. Present rate, 60c. Reason—Contract for which present rates were established has been completed, and it is proposed to place the rates on basis of the Lycoming scale, plus 20c a ton, for two-line movements.

Sup. 1 to 28179. **Sand, blast, engine, foundry, glass, quartz, silex, building and silica**, carloads (See Note 2), from points in South Jersey, South Lakewood, Pinewald, Quail Run, Newport, Cedarville, N. J., etc., to Brighton, Ont., 24½c per 100 lb.

28219. **Crushed stone**, carloads (See Note 2), to Berwick and Lime Ridge, Penn., from Hendler, Penn., $1.10, and from White Haven, Penn., $1.20 per net ton. Reason—Proposed rates are based on Lycoming in P. S. C. Penn. Docket 7530.

28222. **Slag, crude or crushed**, in bulk, carloads (See Note 2), from Sparrows Point, Md., to Marlboro, Md., 90c per net ton. Present rate, $1.05 per net ton. Reason—Proposed rate is comparable with rates to Washington, D. C., New Freedom, Penn., and Charlestown, Md.

28223. **Sand, blast, common, engine, glass, molding, quartz, silica, silex**, carloads (See Note 2), from Tatesville, Penn., to Tiffin, O., 14c per 100 lb. Present rate, 16c per 100 lb. Reason—Proposed rate is comparable with rates from Mapleton, Berkeley Springs and Hancock districts.

28224. **Sand, other than blast, engine, foundry, molding, glass, silica, quartz or silex**, carloads (See Note 2), from Morrisville, Penn., to Price, Md., $1.50 per net ton. Present rate, $1.75 (See Note 5).

28236. **Slag, commercial crushed**, carloads, in bulk, in open top equipment (See Note 2), from Scottdale, Penn., to White Bridge, Penn., 60c per net ton (Present rate 70c.) (See Note 4.)

28248. **Sand, other than blast, engine, foundry, glass, molding or silica and gravel**, carloads (See Note 2), from Baltimore, Md., to B. & O. R. R. stations, Philadelphia, Broad Run, Penn., Newark, Del., Cowenton, Bridewell, Md., Takoma Park, D. C., Germantown, Md., Harpers Ferry, Magnolia, West Romney, Petersburg, W. Va., and South Winchester, Va. Rates ranging from 60c to $1.60 per net ton (See Note 5).

28264. **Sand, silica**, carloads (See Note 2), from Thayer, W. Va., to Alloy, W. Va., $1.25 per net ton. Present rate $2.40, 6th class. Reason—Proposed rate is comparable with rate from Dunfee, W. Va., to Charleston, W. Va.

28271. (A) **Sand, other than blast, engine, foundry, molding, glass, silica, quartz or silex**, carloads; (B) **sand, blast, engine, foundry, molding, glass, silica, quartz or silex**, carloads (See Note 2).

FROM MAPLETON DISTRICT, PENN.

To	—Present— (A)	(B)	—Proposed— (A)	(B)
Mt. Winans, Md.	220	243	6th class	
Weston, W. Va.	205	215	.....	225

FROM TATESVILLE, PENN.

To	—Present— (A)	(B)	—Proposed— (A)	(B)
Mt. Winans, Md.	220	243	*	*
Weston, W. Va.	205	215	.....	225

*No through rate.

Rates in cents per 2000 lb. Reason—Proposed rates are comparable with rates from Berkley Springs district.

28279. **Feldspar**, carloads, minimum weight 40,000 lb., from Bedford Hills, N. Y., to Wellsboro, Penn., 22½c per 100 lb. (Present rate 23½c per 100 lb.) Reason—Proposed rate compares favorably with rates from Bedford Hills to Port Allegany, Penn.

Note 1—Minimum weight marked capacity of car.

Note 2—Minimum weight 90% of marked capacity of car.

Note 3—Minimum weight 90% of marked capacity of car, except that when car is loaded to visible capacity the actual weight will apply.

Note 4—Reason—To meet motor truck competition.

Note 5—Reason—Proposed rates are comparable with rates on like commodities for like distances, services and conditions.

28285. **Limestone, unburned, ground**, carloads, minimum weight 50,000 lb., from Natural Bridge, N. Y., to Barton and Concord, Vt., 21½c per 100 lb. (Present rate 26c, sixth class.) (See Note 5.)

28286. **Limestone, unburned, ground**, carloads, minimum weight 50,000 lb., from Natural Bridge, N. Y., to Norfolk, Raymondville, Chase Mills and Waddington, N. Y., $1.80 per net ton. (Present rate, $2.) Reason—Proposed rate is comparable with rate from Natural Bridge to Norwood and North Lawrence, N. Y.

28289. **Limestone, unburned, ground**, carloads, minimum weight 50,000 lb., from Rosendale and Binnewater, N. Y., to West Norwood, Harrington Park, Haworth, Dumont, Bergenfield, West Englewood, Teaneck, Bogota, Ridgefield Park, Little Ferry, North Bergen and Weehawken, N. J., $1.50 per net ton. (See Note 5.)

28290. **Limestone, unburned, ground**, carloads, minimum weight 50,000 lb., from Watertown, N. Y., to destinations on the N. Y. C. R. R. and West Shore R. R., Thompson's Seneca Mills, Penn Yan, Watkins, Corning, Lawrenceville, Ravena and Glenmont, N. Y., and various. Rates ranging from $1.30 to $1.70 per net ton. Reason—Proposed rate is comparable with rate to Geneva, Canandaigua and Ransomville, N. Y., etc.

27978. **Ground limestone**, carloads, minimum weight 50,000 lb., from B. & O. R. R., Martinsburg-Strasburg groups to Delaware, Elmira, Black Rock, N. Y., 15½c and Solon and Cincinnatus, N. Y., 17½c per 100 lb.

28291. **Waste phosphate rock residue**, carload, minimum weight 100,000 lb., from Carteret, N. J., to Tremley, N. J., 20c per net ton. To apply on shipments of four carload lots at one time. (Present rate, 6th class.) (See Note 4.)

28304. **Crushed slag**, carloads (See Note 2).

FROM EASTON, PENN.

To points in Penn.	Prop. rate	To points in Penn.	Prop. rate
Black Creek Jct.		Quakake	100
Hudsondale	100	Delano	100
Gerhards	100	Park Place	100
Stewarts	100	Mahanoy City....	100
Switchback	100		

FROM BETHLEHEM, PENN.

To points in Penn.	Prop. rate	To points in Penn.	Prop. rate
Black Creek Jct.		Quakake	90
Hudsondale	90	Delano	100
Gerhards	90	Park Place	100
Stewarts	90	Mahanoy City....	100
Switchback	90		

FROM HOKENDAUQUA, PENN.

To points in Penn.	Prop. rate	To points in Penn.	Prop. rate
Black Creek Jct.	80	Switchback	90
Hudsondale	80	Delano	90
Gerhards	90	Park Place.....	90
Stewarts	90	Mahanoy City....	90

Rates in cents per 2000 lb. Reason—Proposed rates are based on Lycoming scale, as shown in P. S. C. Penn. Docket No. 7530.

28305. **Stone, chips, dust or waste**, N. O. I. B. N. in O. C., **natural, other than bituminous asphalt rock**, carloads (See Note 2), from Tuckahoe, N. Y. (per net ton). (See Note 5.)

To points in New York	Prop. rates	To points in New York	Prop. rates
Long Island City..	$2.50	Group B points.....	3.10
Blissville	2.50	Group C points.....	3.35
Nichols Siding	2.50	Group D points.....	3.85
Group A points.....	2.85		

SOUTHERN FREIGHT ASSOCIATION DOCKET

56439. **Phosphate rock, ground or pulverized**, from Nashville, Tenn., to Kenosha, Wis. Present rate, 573c per net ton. Proposed rate on phosphate rock, ground or pulverized, viz., acidulated (acid phosphate), in packages or in bulk, or superphosphate (acid phosphate), in packages or in bulk, straight or mixed carloads, minimum weight 40,000 lb., 490c per net ton—made in line with rates applicable from southern points to C. F. A. territory.

56316. **Bituminous rock asphalt**, from producing points in Kentucky to Georgetown, O. Combination rates now apply. Proposed rates on bituminous rock asphalt as described in Agent Speiden's I. C. C. 1388, from all producing points in Kentucky, as published in tariff mentioned to Georgetown, O., 280c per net ton, made in line with rates that have been established to other destinations in C. F. A. territory on this traffic.

56317. **Bituminous asphalt rock**, carload, Big Clifty, Black Rock, Rockport and Summit, Ky., to St. Louis Park, Minn. Class or combination rates now apply. Proposed rate on bituminous asphalt rock, carload, as described in Item 1, page 12, I. C. R. R. Tariff I. C. C. 7649, from and to points mentioned, 500c per net ton, same as currently in effect to St. Paul, Minn.

56325. **Sand, gravel, slag, crushed stone and chert**, Birmingham, Bessemer, Ensley and Mobile, Ala., to East Moss Point, Miss. It is proposed to establish reduced rates on sand, gravel, crushed stone, slag and chert, carload, as described in Agent Glenn's I. C. C. No. A-655 to East Moss Point, Miss., from Birmingham, Bessemer, Ensley and Mobile, Ala., $1.65 per net ton; from Mobile, Ala., 70c per net ton—same as currently in effect to Kreole, Miss.

56326. **Sand, gravel, slag, crushed stone and chert**, carload, between stations on the L. & S. R. R., and between stations on the L. & S. R. R. on the one hand and points in S. F. A. territory on the other. It is proposed to establish main line or trunk line basis of rates on sand, gravel, slag, stone and chert, carload, to, from and between stations on the Laurinburg and Southern R. R.

56335. **Sand and gravel**, carload, from eastern and Virginia points to Florida destinations. It is proposed to amend distance scales shown in Section 2 of Agent Glenn's Tariff 108, I. C. C. A-688 (Florida sand and gravel tariff) so as not to apply from points on Southern Ry. north of Lynchburg, Va., to destinations on the A. C. L. R. R., S. A. L. Ry., F. E. C. Ry. and other Florida lines connecting with these lines

SOUTHWESTERN FREIGHT BUREAU DOCKET

23901. **Lime rock or limestone**, from Mosher and Ste. Genevieve, Mo., to Ottawa, Ill. To establish a rate of $1.90 per ton of 2000 lb. on lime rock or limestone, broken, crushed or ground, carloads (See Note 1), but not less than 40,000 lb., from Mosher and Ste. Genevieve, Mo., to Ottawa, Ill. It is stated that at present class rates apply. The distance from Mosher and Ste. Genevieve, Mo., to Ottawa, Ill., is 275 mi. It is stated that this rate compares favorably with rates from competing producing points.

CENTRAL FREIGHT ASSOCIATION DOCKET

29992. To establish on **crushed stone**, carloads, from Carey, O., to Greenwich, Hereford, Nova, Sullivan and Homer, O., rate of 80c per net ton. Present rates, 90c to Greenwich and Hereford, and 100c to Nova, Sullivan and Homer, O., per C. C. C. & St. L. Ry. Tariff 1906B.

Reelect Colonel MacNider President

A SATISFACTORY YEAR in sales and shipments and a larger number of orders on the books than a year ago, was the report made by officers at the annual meeting of the Northwestern States Portland Cement Co. held in its offices at Mason City, Ia., recently.

Colonel Hanford MacNider was reelected president and general manager of the company, while Frank J. Hanlon, formerly director, was elected vice-president, taking the place of A. F. Frudden of Hollywood. Willis G. C. Bagley was reelected treasurer.

A new figure was added to the board of directors in the person of William Stern, cashier of the Dakota National Bank of Fargo. There was no other change in the board of directors.

Officers reported that while sales had held up well in the past year, earnings had been affected by the depression and a virulent price war in the industry.

Fred A. Ontjes, one of the stockholders of the company, presented the claims under which he is bringing suit seeking to enjoin the company from reorganizing from a West Virginia to an Iowa concern. The other stockholders refused to join him in the action, indicating he was alone in his position. —*Mason City* (Ia.) *Gazette.*

Quarry Company Chartered

THE KANSAS charter board granted a charter recently to the Tri-State Quarry Co. of Junction City, Kan., with an authorized capital of $120,000. Charles O. Monson, John A. Swenson, H. Leland Enos, V. R. and F. W. Enos and Attorney Bischoff of Abilene and W. H. Clarkson of Manhattan are the organizers.

The company has control of over 1400 acres of quarry at Peoria, Okla., and has mills at Peoria and Kansas City.

The special rock underlying its quarries is used in the manufacture of roofing, paving, composition flooring, fire brick, etc.—*Junction City* (Kan.) *Republican.*

Joseph Uhlman

JOSEPH UHLMAN, veteran safety director of the Richard City, Tenn., plant of the Pennsylvania-Dixie Cement Corp., died of apoplexy on December 8. He was apparently in good health and spirits when he left the plant at the completion of his day's work and his sudden passing shortly afterward was a shock to the entire community. At the time of his death he was 51 years of age and had been employed at the Richard City plant for 23 years.

"Joe" Uhlman, as he was always known, was a native of Paris, Ohio, and his parents later moved to southern Michigan. He was quite young when he joined the Michigan regiment and served in the Spanish-American war.

Prior to his employment by the Pennsylvania-Dixie company he was employed by the Wolverine Portland Cement Co. at its Coldwater and Quincy (Mich.) plants, and the Peerless Portland Cement Co. at its Union City, Mich., plant. He joined the force of the Dixie Portland Cement Co. at the Richard City mill early in 1909 to take care of Griffin mill repairs. At that time there were 48 Griffin mills in operation in

Joseph Uhlman

the plant and Mr. Uhlman was able to show excellent results with them.

The Richard City plant became one of the pioneers of the cement mill safety work and Mr. Uhlman, who showed unusual interest and a marked aptitude both in guarding machinery and in keeping men out of danger, was made safety director in addition to his other work. Mr. Uhlman devoted a great deal of time and study to this matter with results which were soon very noticeable. During the last few years he had been a familiar figure at the southeastern regional safety meetings of the Portland Cement Association, all of which he attended, contributing freely of his broad information both along technical and practical lines.

Lime Production in Canada for September

CANADIAN lime production recorded a 5.7% increase in September. According to the Dominion Bureau of Statistics at Ottawa, shipments during the month totaled 30,668 tons, while in August 29,010 tons were produced and in September last year 39,526 tons. The month's lime production in Quebec showed an appreciable advance over the August total. Ontario's production continued at practically the same level as in the previous four months. Manitoba and British Columbia operators reported increased shipments during the month. The total Canadian production in the first nine months of 1931 was 279,131 tons or 26.3% below the shipments of 378,497 tons for the corresponding period of 1930.

Kansas City Quarry Concern in Receivership

THE Consumers' Material Corp., a $1,000,000 concern owning several rock quarries and crushing plants near Kansas City, Mo., recently was placed in receivership by Judge Otis of the federal court.

Henry S. Conrad, attorney, and Howard P. Treadway, vice-president of the Kansas City Bridge Co., were appointed receivers.

The application for receivership was filed by the English Brothers Machinery Co.

A contract whereby the Consumers concern leased the entire property to the Stewart Sand and Material Co., January 6, 1930. will remain in force, the judge ruled. Under the contract the Consumers company is to receive 60% of the profits from operation of the property under the management of the Stewart company.

No allegation of insolvency is made against the Consumers company in the petition for receivership. It states that it is the belief of the petitioner that the company's assets exceed $1,000,000 and that it can meet all obligations if properly managed under court supervision.

Included in the liabilities are two bond issues, a first mortgage issue of $497,500, and a second mortgage issue of $78,810, on which interest payments are past due.

Officers of the corporation are R. Newton McDowell, president, and Lawrence R. Peairs, secretary-treasurer. — *Kansas City* (Mo.) *Journal.*

Stops City from Selling Crushed Stone

THE CITY of Winchester, Va., has been enjoined by court injunction from selling crushed stone to any one in the future.

Suit for the injunction was filed by the M. J. Grove Lime Co., Inc., and Henry Bell, both engaged in the stone business, who charged the city, as a nontaxpayer, was engaged in competition in the sale of crushed stone to the state highway commission.

As a result of the injunction, about 60 prisoners who had been engaged in quarrying and crushing the stone, were returned to jail.—*Richmond* (Va.) *Times-Dispatch.*

Extends Permission to Operate Gravel Plant

DESPITE the opposition of residents of the section to the petition of the Garden City Sand and Gravel Co., Waltham, Mass., for an extension of its permit to operate its plant, the aldermanic claims and rules committee will recommend that the petition be granted.

As a concession to the opponents of the petition, however, the committee added in its report the condition that no operations shall begin at the pit until 7 each morning.—*Waltham* (Mass.) *News-Tribune.*

And Let's Smile!

Culled from Many Sources, for at Least One Smile?

IN a former depression, this letter of a merchant of German descent to his salesman on the road, made the rounds of the newspapers:

"Ve haf received yur letter of de 18th instunt mit exbense account und route list. Vot ve vont iss orders. Ve vont no veather reports, nor mabs of Ohio, und ve haf big families ov our own to make exbenses. Ve find in yur exbense account tu dollars und a haff for bilyards. Please dont bi any more bilyards for uss. Vot ve vont iss orders."

In line with the recently advocated meter charges for banking services, a wag suggests the following new set of service charges:

1. Entering bank:	
By front door	$0.50
By side door	.25
2. Calling by telephone:	
First call	.10
For each call thereafter	.05
3. Asking for balance	1.00
4. Arguing over amount of balance:	
In civil manner	.50
In qarrelsome manner:	
For first time	2.50
For each time after first	5.00
5. Spitting on floor:	
Plain	.05
Tobacco	.10
6. Speaking to officers:	
To president	1.00
To vice-president	.75
To assistant vice-president	.04
To cashier	.50
To any assistant cashier	.15
To anyone else	No charge

"Can you loan me five dollars?" asked Jones.

"Sure," said Smith. "Would you rather have an old five or a new one?"

"A new one, of course," said Jones.

"Here is the one," said Smith. "I'm four dollars ahead."

"The most amazing coincidence I ever remember was the eleventh day of the eleventh month, and I lived in a house with number eleven on the door, and I backed the eleventh horse in a race."

"And the horse won, I suppose?"

"Nothing of the kind. The beastly animal came in eleventh."

"No, I can't give you an appointment this afternoon; I have eighteen cavities to fill," said the dentist as he turned from the telephone and picked up his golf clubs.

If you are broke, read this letter from an Oklahoman to his banker and feel better:

"It is impossible for me to make a further payment on my note. My present financial condition is due to the effects of federal laws, state laws, county laws, corporation laws, by-laws, mother-in-laws and outlaws that have been foisted upon an unsuspecting public. Through these various laws I have been held down, held up, walked on, sat on, flattened and squeezed until I do not know where I am and why I am.

"These laws compel me to pay a merchant's tax, capital stock tax, income tax, real estate tax, property tax, auto tax, gas tax, water tax, light tax, cigar tax, street tax, school tax, syntax and carpet tax.

"The government has so governed my business that I do not know who owns it. I am suspected, expected, inspected, disrespected, examined, reexamined, until all I know is that I'm supplicated for money for every known need, desire or hope of the human race, and because I refuse to fall and go out and beg, borrow or steal money to give away, I am cussed and discussed, boycotted, talked to, talked about, lied to, lied about, held up, held down and robbed until I am nearly ruined; so the only reason I am clinging to life is to see what the h—— is coming next."

An auto tourist was traveling through the great Northwest when he met with a slight accident to his machine. In some way he had mislaid his monkey wrench, so he stopped at a nearby farmhouse, where the following conversation took place between himself and the Swede farmer:

"Have you got a monkey wrench here?"

"Naw; my brother he got a cattle rench over there; my cousin he got a sheep rench further down this road; but too damn cold here for a monkey rench."

"How did they treat you in Scotland?"

"Reluctantly."

The farmer's pink-cheeked daughter was coming up the lane. She was clad in grimy overalls, from the pockets of which bulged bunches of waste and sundry wrenches and pliers. In her hand was a dirty satchel of iron tools.

"Where are you going, my pretty maid?"

"I'm going a-milking, sir," she said.

"But why the tools, my pretty maid?"

"Trouble," she said, "with that blamed milking machine again."

George Ade tells about an Indianapolis lawyer who had a friend visiting him who was a great admirer of James Whitcomb Riley, the Hoosier poet. So the lawyer got out his car and took his friend down to Greenfield, Ind., which is where Riley was born.

The two had dinner at the hotel, and then decided to go out and see the house where this great event happened.

So they asked the hotel keeper, "Where is the Riley house?"

"Never heard of any hotel here by that name," the hotel keeper told them, "but there might be a boarding house called that."

"I mean the James Whitcomb Riley house."

"I don't know him. Mebbe he's in the city directory," and he pushed the book across the counter.

"I guess he's moved," said the lawyer.

"Probably," assented the hotel man. "Some of them Irish don't stay long in a place."—*Saturday Evening Post.*

Professor—I am going to speak on liars today. How many of you have read the 25th chapter of the text?

Nearly every student raised his hand.

Professor—Good. You are the group to whom I wish to speak. There is no 25th chapter.

A man had been riding in a stuffy smoking car, and when the train stopped at the station he went out on the platform and took a deep breath of fresh air. In his enjoyment, he said to the brakeman: "Isn't this invigorating?"

"No, sir," was the reply; "this is Cochecton."

The editor of a poultry journal received a letter from a woman reader. It read: "How long should a hen remain on the eggs?"

The editor replied: "Three weeks for chickens and four weeks for ducks."

Three weeks passed and the editor again received a letter from the reader: "Thank you very much for your kind advice," it read. "The hen remained on the eggs for three weeks and there were no chickens hatched, and as I did not care for ducks, I took her off the nest and sold the eggs."

An Austin was dashing down a city street at 50 miles an hour and at intervals would bob into the air like a grasshopper, alight and careen madly on its course. A motorcycle policeman pursued the trinket, finally overtook it, and made the driver halt.

"What's the idea of leaping up and down the street at 50 miles an hour?" he snapped.

"Believe it or not, officer," replied the driver, "I've got the hiccoughs."

A minister told his flock that he had a "call" to go to another church. One of the deacons asked how much he was offered.

"Three hundred dollars," was the reply.

"Well, I don't blame you for going," remarked the deacon, "but you should be more exact in your language, parson. That isn't a 'call,' that's a 'raise.'"

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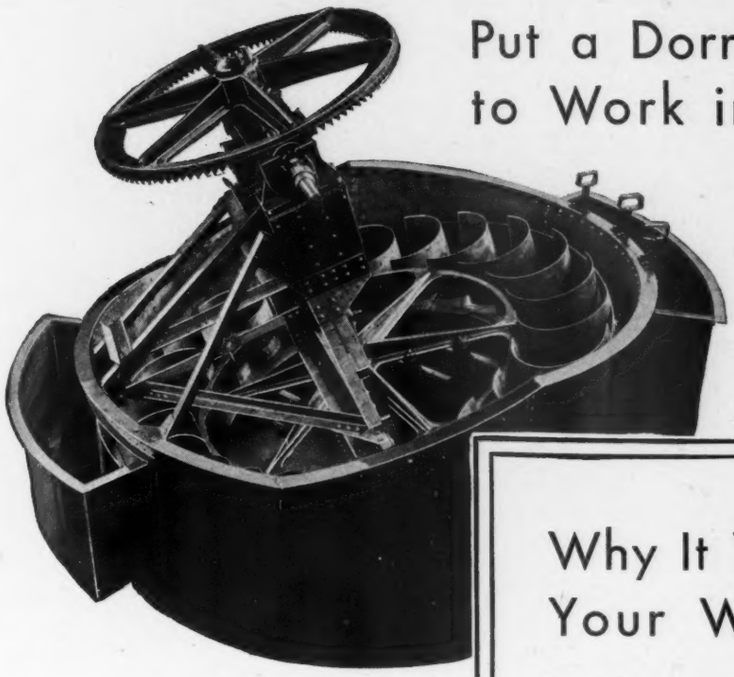

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